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THE ROENTGENOLOGIC DIAGNOSIS OF COARCTATION OF THE AORTA (ADULT TYPE)*

By WALTER W. FRAY, M.S., M.D.
ROCHESTER, NEW YORK

THE diagnosis of coarctation is rarely made during life, though post-mortem experience would indicate that this condition is not extremely uncommon. King[7] noted that only 4 cases have been recognized clinically at the Johns Hopkins Hospital during the course of thirty-seven years. Abbott[1] in an exhaustive review of the literature, in which a total of 200 autopsied cases are carefully analyzed, found that a virtual diagnosis of obstruction of the thoracic aorta had been made in 28 cases and of these 21 were diagnosed as definite coarctations. Thus in approximately 86 per cent of the cases the diagnosis was missed clinically and autopsy was required to identify the condition.

We have recently had the opportunity of making a complete roentgen study of 2 cases of coarctation and are presenting the findings in some detail. We intend to show that this condition offers certain definite roentgenologic features, upon which the diagnosis can be successfully established.

The roentgenologic aspects of this anomaly have not been definitely considered in the past by roentgenologists but have been discussed by clinicians, whose opinion of the roentgen diagnosis is not based upon modern roentgenologic knowledge or technique.

Reports in the literature dealing with its clinical aspects express a very pessimistic attitude concerning the help which a roentgen examination may give. King[7] states that "roentgenograms are disappointing," adding that the location of the coarctation behind the cardiovascular stripe makes it an unfavorable site for inspection and concludes that "the chief value of the roentgen-ray is the ruling out of aneurism." Blackford[3] writes a similar opinion: "Roentgenologic examination of the thorax is of value in excluding aneurysm which has been the most common erroneous diagnosis but the presence of aneurysm does not exclude coarctation." He adds that it is also of some value in excluding intrathoracic neoplasm.

Roentgenologic periodicals, textbooks and monographs (Vaquez and Bordet,[15] Köhler,[9] Holmes and Ruggles,[6] and others) dealing with roentgen diagnosis either do not mention the condition or give no satisfactory criteria upon which to base the diagnosis. There is therefore very little opportunity for the roentgenologist to familiarize himself with the differential diagnosis of coarctation, though the recent articles of Abbott,[1] and Railsback and Dock[13] have aided in this regard.

The roentgenologist has an excellent opportunity to make this diagnosis, entirely

*From the Department of Radiology, Strong Memorial Hospital, and University of Rochester, School of Medicine and Dentistry, Rochester, N. Y.

unaided by clinical or laboratory data. It should be possible to establish the diagnosis in practically every case in which a complete roentgen examination of the heart

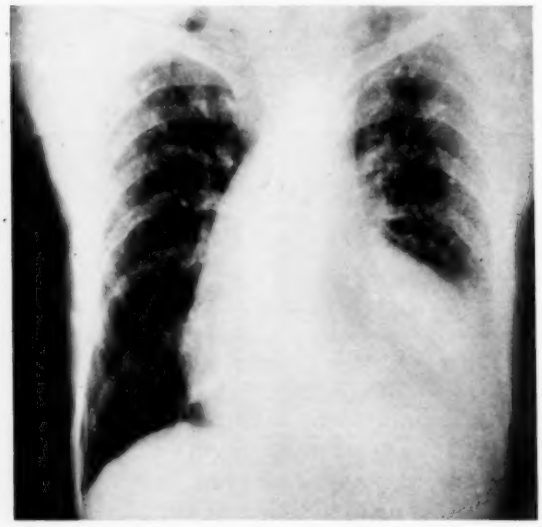

Fig. 1. Case 1. Roentgenogram of the chest taken in the posteroanterior position. Note the absence of the aortic knob, the presence of a left ventricular hypertrophy, the prominence of the ascending aorta and the erosion of the ribs.

and aorta can be made. The manner in which this can be accomplished, together with an analysis of the diagnostic features, will be discussed in detail after the presentation of 2 cases.

In the following two case reports only the data relative to the condition of the coarctation and its diagnosis will be given.

Case 1. R. D., male, white, single, aged fifty-seven, entered the Rochester Municipal Hospital on Dec. 8, 1927, complaining of anorexia and weakness of two weeks' duration. He had always enjoyed good health, supported himself and worked as an employee in a button factory. There was no significant history of infections such as rheumatic fever or tonsillitis. He had, however, been refused life insurance eighteen years previously, and occasionally in the past had noted a "fluttering" of his heart, and for fifteen or twenty years had noted some dyspnea on exertion. His family history was negative.

His present illness began rather insidiously with feverish sensations, anorexia and weakness. Dyspnea became more marked and nocturia developed. He had been forced to quit work five days before his admission and had lost 10 pounds in weight.

Physical examination showed a thin, undernourished adult male. The teeth were in poor condition. Pulsating neck and thoracic vessels were particularly marked in the suprasternal notch and right supraclavicular region, and there were also large tortuous pulsating vessels in the axillae and over the scapulae. The chest showed a limited excursion with impairment of percussion note, a few rales and suppressed breath sounds at the left base. The heart was diffusely enlarged, with a forceful apex beat and a systolic thrill, palpable over the aortic region and apex. The first sound was booming while the second sound was heard only over the pulmonic area. A loud systolic murmur was heard over the entire precordium, varying in character according to the location. At the left nipple there was a constant to-and-fro murmur. The liver was palpable 3 cm. below the costal margin. Deep reflexes were sluggish throughout. The retinal vessels were moderately sclerosed. Temperature, 35.3°–40°C.; pulse, 80–130; blood pressure, 122/86.

Laboratory data obtained were as follows: Blood: hb., 100 per cent; red blood cells, 4,570,000; white blood cells, 21,900. Smear normal. Urine: trace of albumin; many granular casts; white and red blood cells in sediment. Sputum negative for tubercle bacilli. Vital capacity 1700. Phenolsulphonphthalein test 60 per cent in three hours. Blood culture: 4–20 colonies of *Streptococcus viridans* per c.c. Electrocardiograph: auricular fibrillation; intraventricular block.

Roentgenologic Data. Chest examination (posteroanterior, left and right posteroanterior oblique films, Figs. 1 and 5) was made on Dec. 10, 1927, approximately five weeks before death. Both the apices and infraclavicular regions showed changes suggestive of an old pulmonary tuberculosis. The right diaphragm was irregular in contour as a result of adhesions. The left diaphragm could not be identified, owing to the greatly enlarged heart, the apex of which reached the left lateral chest wall. The heart appeared enlarged in all of its diameters, the hypertrophy of the left ventricle being particularly massive. The width across the base of

the heart was increased and the auricular dilatation was so pronounced as to suggest a tricuspid insufficiency. The supracardiac area was greatly increased and this to a large degree was due to the prominence of the ascending aorta. One of the striking features noted at this examination was the complete absence of the aortic knob, a remarkable finding for a man of fifty-seven years. The cardiac measurements were: great vessels, 8.5 cm.; longitudinal diameter, 22.5 cm.; transverse diameter, 19.8 cm.; width of auricles, 15.5 cm.; internal diameter chest, 25.5 cm. These findings were summarized as follows: generally dilated and hypertrophied heart with massive left ventricular hypertrophy and extreme auricular dilatation, the latter being more marked on the right, suggesting a tricuspid insufficiency. The absence of the aortic knob and failure to visualize a considerable portion of the arch in the left oblique view suggested a congenital anomaly of this vessel, but a definite diagnosis of coarctation was not made at the original examination. Other findings were diaphragmatic adhesions, apical scarring of tuberculosis and probable small effusion in left pleural cavity. A peculiar notching of one of the ribs was noted but its significance was not recognized at the time.

From the day of admission, the temperature varied in wide swings, gradually reaching a peak of 40°C. The pulse varied in proportion, with an average of 100. The patient gradually grew weaker and heart action became more labored. The first sound was finally entirely replaced by the murmur. Emaciation became more marked and death occurred, without further roentgen examination, on Jan. 17, 1928.

Clinical Diagnosis. Coarctation of aorta. Acute pancarditis (*Streptococcus viridans*). Left pleural effusion. General arteriosclerosis. Acute nephritis.

Autopsy—Jan. 18, 1928, by Dr. G. H. Whipple. Résumé of findings of the heart and lungs.

The pleural cavities showed dense adhesions at the apices; the pericardial cavity was obliterated by partially organized adhesions which were fairly tough but not dense. The pericardial layers showed definite rusty staining, suggesting digested blood.

Heart. Measured at least 14 cm. transversely in situ; weight 730 gm. together with pericardium and great vessels. The hypertrophy affected the left ventricle particularly. The right auricle was distended and thickened; the coronary sinus was distended to twice or three times its normal diameter. The tricuspid ring was greatly dilated, the orifice of which was practically filled with a cauliflower-like mass of vegetations adherent to the ring, which appeared to protrude from this region rather than adherent to the valves. It was found that this enormous mass of vegetations came from the extension of the primary process back of the aortic leaflets. The leaflets of the tricuspid were thin, delicate and uninvolved. The right ventricle was found moderately hypertrophied and dilated. The intima was smooth, the muscle normal. The pulmonary artery showed no arteriosclerosis. It was almost completely occluded by thrombus masses, probably by extension from below or by fragments from the tricuspid valve region. Several of the smaller pulmonary vessels were also plugged with thrombi.

The left auricle was greatly dilated and hypertrophied. The mitral ring was not dilated. The valve leaflets in general were normal but there were two old scars which joined the bases of the two mitral leaflets, narrowing the orifice a little. This area, however, was closed over with smooth endothelium. It appeared to be a healed injury (related to the aortic injury) from which healing has been almost complete, with return to normal. The left ventricle was a little dilated and showed great hypertrophy of the muscle wall, measuring over 2 cm. in thickness. The papillary muscles showed scars at their tips and on tangential section the heart muscle showed everywhere gray and silver patches, usually of small size. The aortic region showed extreme deformity of the valves and vegetations on the under surface. Opened from above, the aortic ring showed great deformity with only a small button-like opening about 1–1.5 cm. long. Two of the leaflets sagged away from their common point of insertion with fusion of these cusps into one large, deformed, calcified cusp which formed one side of the opening. The other cusp was similar in form and thickened with a round rolled margin. Below this rounded margin in both angles were found rough granular vegetations. There was quite a mass of these vegetations, some of them having a slaty gray color.

It was believed that the inflammatory process had spread through the interventricular

tissue to form the fungous vegetations at the site of the tricuspid ring. There was a small distinct passage from the vegetations just below the aortic cusps to the center of the tricuspid vegetations.

The aorta showed a moderate amount of arteriosclerosis in its arch. An enormous innominate artery was seen from which a mammary vessel, measuring 5 or 6 mm. in diameter, arose. This vessel, which on section showed definite calcification of the media, was thickened, tortuous, and ran down along the inner surface of the manubrium, anastomosing with the hypogastric through arterioles which were at least 3–4 mm. in diameter. The carotid going to the left side came off the arch in the normal way and was about normal in size. The subclavian, on the other hand, was 2–3 times its normal size and gave off a large mammary artery, anastomosing as the other one. Following the aorta, just beyond this third branch, one came to a blind pocket (Fig. 2). The aorta began again after a space of about 1–1.5 cm.

Fig. 2. Case 1. Autopsy specimen illustrating the complete atresia of the aorta. Note the dilated openings of the upper intercostal arteries.

as a blind pouch into which opened several intercostals which were enormously dilated, some of the larger ones measuring 6–7 mm. in diameter. Some of the thoracic intercostals 6–8 cm. below this were also dilated and evidently afforded collateral supply. Arising from the convexity of the arch about opposite the left carotid was a puckered dimple from which a fibrous cord ran to the region occupied by the upper blind end of the thoracic aorta. This obviously was either the strictured portion of the aorta or the remains of the ductus arteriosus. The abdominal aorta was decidedly hypoplastic, quite elastic, thin walled, and obviously did not carry the normal amount of blood. The renal arteries were smaller than normal. The common iliacs were small and there was much less sclerosis here than in the hypogastrics.

Lungs. The left lung was small, flabby and decidedly atelectatic. There was no great excess of fluid in the pleural cavity, though there may have been a small amount. The lung showed an old tuberculous focus in the apex, covered by adhesions. The lower lobe showed a flabby doughy lung tissue almost free of air. There were one or two hemorrhagic infarcts in this area. The pulmonary artery going to this lower lobe was almost completely occluded by an organizing thrombus and it was believed that a part of the atelectasis was due to shutting off of the blood supply. The right lung by contrast was quite heavy and voluminous. It also contained a fibroid apical scar of healed tuberculosis. The middle and lower lobes showed typical hemorrhagic infarcts. The lung tissue adjacent was very wet and boggy, showing much edema. Some of the thrombous masses in the small vessels showed softening in their centers suggesting infection. The pleural surfaces over some of the infarcts showed a beginning inflammatory reaction.

Complete Anatomical Diagnosis. Aortic anomaly with stricture (coarctation). Hypertrophy and dilatation of collateral arterioles. Arteriosclerosis. Subacute aortic endocarditis with stenosis. Ulcerative aortic endocarditis with extension into the tricuspid ring. Chronic endocarditis (mitral). Extreme cardiac hypertrophy and dilatation with diffuse fibrous myocarditis. Organizing obliterative pericarditis. Emboli and thrombi of pulmonary artery with extensive infarct formation, particularly

in right lung. Thrombosis of prostatic plexus. Pulmonary edema and acute pleuritis. Bilateral apical scars of lungs with chronic adhesive pleuritis. Emphysema. Multiple duodenal ulcers with acute fibrinous peritonitis. Hemorrhage into intestines. Chronic adhesive peritonitis. Encephalomalacia. Surface atrophy of liver. Thyroid adenomata. General emaciation.

Case II. R. W., male, white, married, entered Strong Memorial Hospital on July 23, 1929, complaining of hot painful swelling of the left foot of two months' duration.

The onset of the swelling was sudden and occurred without any obvious cause. It was painful even when quiet but was made worse on motion. The foot became red only after soaking it in mustard water. After a week of rest, it gradually improved without any specific treatment. Twice since the onset the swelling had recurred and on one occasion vesiculation of the skin followed the use of mustard baths. The patient had no other complaint except he was 13 pounds under his usual weight.

His past history was essentially negative, without history of rheumatic fever, chorea or frequent sore throats. He noted dyspnea only on greatest exertion. He had not noted palpitation, chest pains or chronic cough. The family history was non-contributory.

On physical examination the patient appeared to be a healthy well-developed, fairly well-nourished adult male, not acutely ill. The left ankle and foot were hot, swollen and covered with small vesicles. The upper border of the red area formed a distinct line immediately above the malleoli. Motion of the joint caused no pain. The lungs were clear. A marked diffuse systolic impulse was noted over the entire precordium, maximal over sixth interspace, 13.5 cm. from mid-sternal line. The heart was greatly enlarged to the left and downward. Heart sounds were forceful. A loud diastolic murmur was heard best over the aortic area. The dorsal scapular arteries and the intercostal and epigastric arteries were enlarged and pulsating. No pulsations could be felt in the abdominal aorta, femorals or popliteals, and only a weak pulsation was palpable in the posterior tibials and dorsalis pedis arteries. Radial pulses were of the Corrigan type. Abdominal examination was negative.

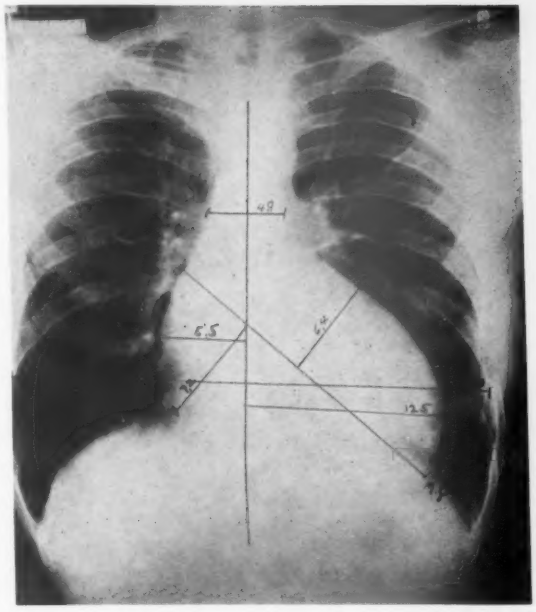

Fig. 3. Case II. Roentgenogram of the chest taken in the posteroanterior position, showing findings similar to those of Case I. The rib erosion is better illustrated in this case.

Reflexes active. Temperature, 37.5°C.; pulse, 88; respiration, 22; blood pressure, 190/80.

Laboratory Findings. Blood: red blood cells, 5,510,000; white blood cells, 8,400; hb, 102 per cent. Differential count and smear normal. Urine: very heavy trace of sugar; diacetic acid test positive. Stool: negative. Blood chemistry: sugar, 149; nonprotein nitrogen, 42; Wassermann reaction, negative. Electrocardiograph: Left ventricular preponderance; first degree heart block; myocardial damage. Sugar tolerance test: fasting, 85; ½ hr., 131.2; 1 hr., 168, and 2 hr., 172.4. Blood culture: negative.

Roentgenologic Data. Routine posteroanterior and left and right posteroanterior oblique films of the thorax were made (Figs. 3 and 6). Both apices appeared clear. The contour of the left diaphragm was slightly irregular suggesting adhesions. The heart and great vessels were of chief pathological interest. The heart was enlarged in all of its diameters, particularly in its transverse and longitudinal diameters, its shape suggesting a massive left ventricular hypertrophy and moderate auricular dilatation. In the posteroanterior film, the configuration of the aorta appeared distinctly abnormal. The

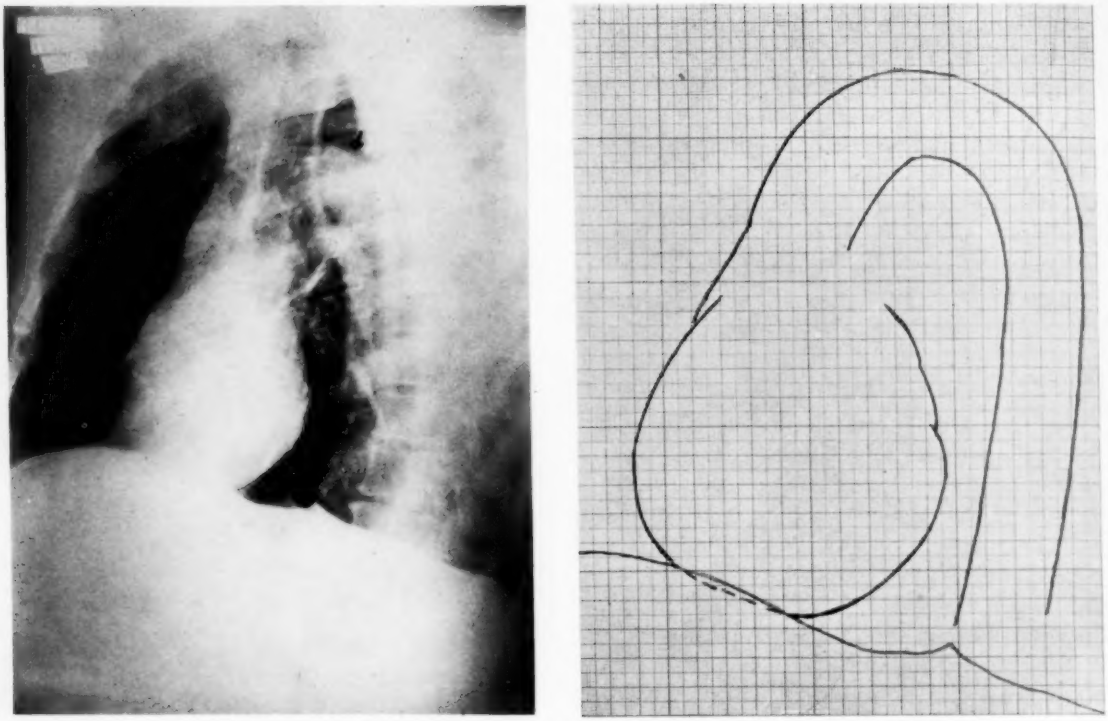

Fig. 4. Roentgenogram (untouched) of chest taken in the left posteroanterior position, with drawing showing normal aorta (for purposes of comparison). Note the sharp definition of the arch at the arrow.

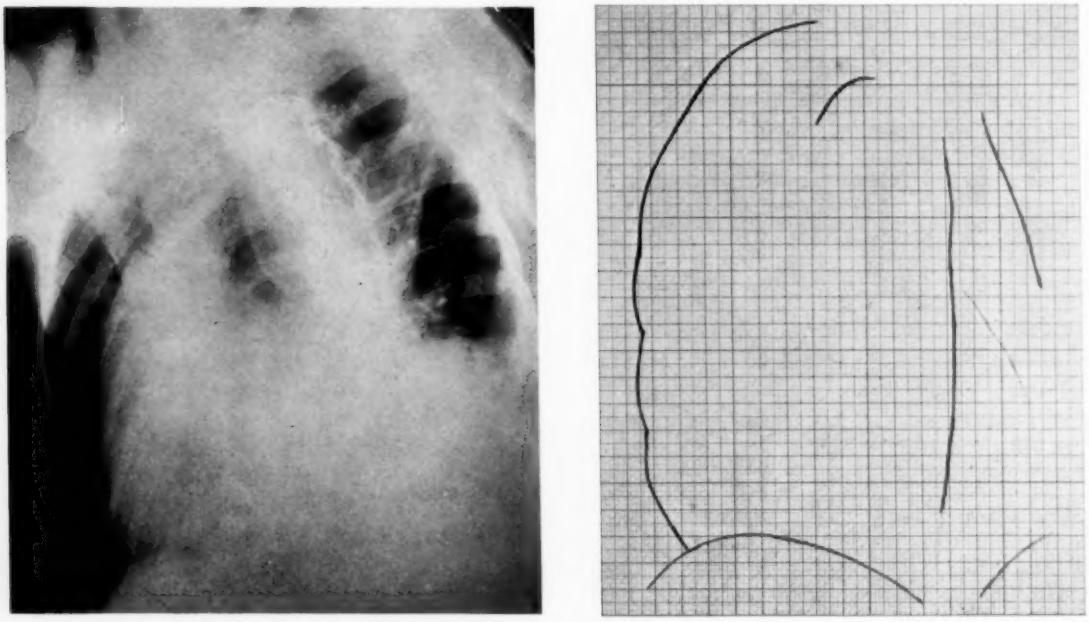

Fig. 5. Case 1. Roentgenogram (untouched) of chest taken in the left posteroanterior oblique position, with drawing illustrating the defective arch. The left pleural effusion obscures the apex of the left ventricle; the dilated ascending aorta is evident.

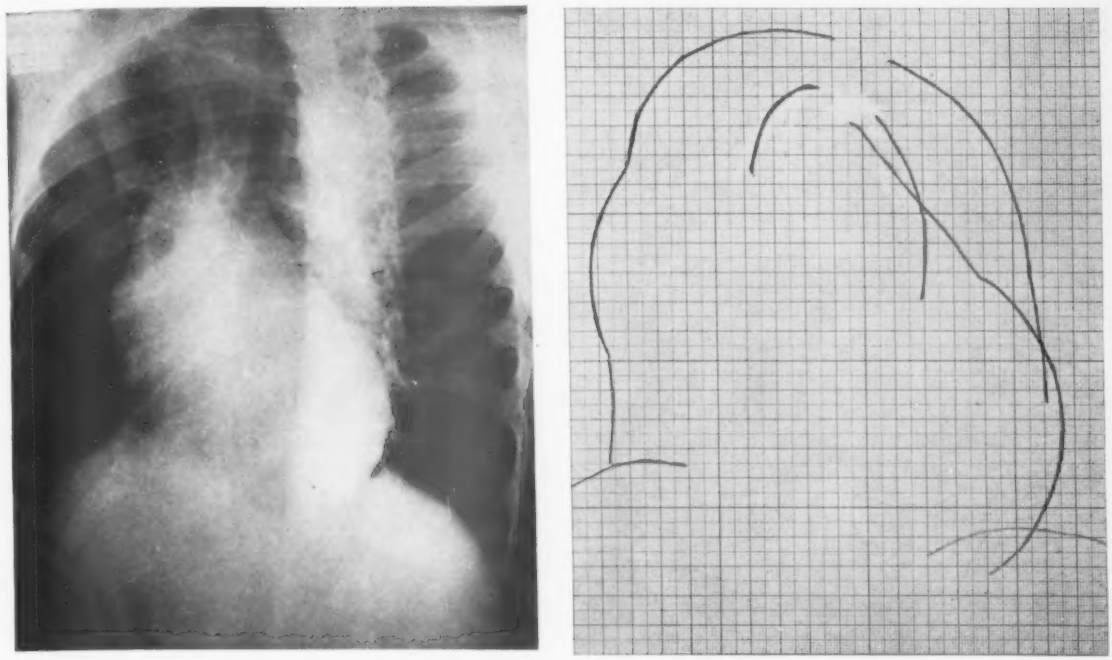

Fig. 6. Case II. Roentgenogram (untouched) of chest taken in the left posteroanterior oblique position, with drawing illustrating the defective arch. The massive left ventricle, the dilated ascending aorta and rib erosion are also shown.

ascending aorta was moderately dilated and the aortic knob entirely absent. In the left posteroanterior oblique film, the transverse portion of the arch could be outlined, but as the descending limb of the arch was reached the shadow faded out and became very indistinct. This suggested that the descending limb was at least in part obliterated and that the dilatation of the ascending aorta was secondary to this obstruction. A striking feature, noted at the time of this examination, was the erosion of several of the ribs on both sides, undoubtedly due to blood vessel pressure and definitely suggesting collateral circulation, carrying a large volume of blood. Bone erosion was noted at the seventh and ninth right ribs and the fifth, eighth and ninth left ribs posteriorly. The cardiac measurements were: great vessels, 4.9 cm.; longitudinal diameter, 19.8 cm.; right media, 5.5 cm.; left media, 12.5 cm.; width auricles, 13.6 cm.; internal diameter chest, 30.0 cm. The roentgen findings were summarized at this examination as a coarctation of the aorta (adult type) based upon the following four features: absence of aortic knob in the posteroanterior view; dilatation of the ascending aorta; absence of a portion of the aortic arch in the oblique view; marked enlargement of the left side of the heart and rib erosion as a result of a collateral circulation involving the intercostal arteries.

Course in the Hospital. Except for slight rise in temperature for the first few days, the temperature, pulse, and respirations were normal. He was kept in bed with the left foot elevated and in five days it was practically normal. His mild diabetes was easily controlled by diet and he was finally raised to a diet of 2500 calories. It was suggested that the swelling of the left foot was due to circulatory disturbance. Discharged to his local physician after fourteen days in hospital.

Clinical Diagnosis. Coarctation of aorta (adult type); diabetes mellitus (mild).

Subsequent Note. This patient died at home with signs of a cardiac decompensation eight months after his discharge. Autopsy permission was denied.

A summary of these two cases shows many points of similarity. Both were male adults without previous history of rheu-

matic fever, chorea, or lues. Neither gave any history of repeated cardiac breaks. Both had always been self supporting and had worked up to the time of their present illness, one as a worker in a factory, the other as a clerk. Clinically both showed evidence of a collateral circulation.

Roentgen studies obtained by the technique described below, showed five fundamental points in common: (1) Absence of aortic knob in posteroanterior view; (2) defect in aortic arch in left posteroanterior oblique view; (3) rib erosion in both views; (4) dilated ascending aorta, and (5) left ventricular hypertrophy.

ROENTGENOLOGIC TECHNIQUE

If coarctation is suspected, a very careful roentgenoscopic examination of the thoracic aorta should be made from all angles, searching particularly for a defect in the continuity of the arch, unusual pulsations and dilatation of the ascending aorta, with possible aneurysm from dilatation of the weakened wall proximal to the obstruction, collateral circulation changes with enlargement of the vessels in the superior mediastinum, and finally, erosion of the ribs posteriorly. The usual routine posteroanterior film and a left posteroanterior oblique film of the chest should be obtained. The latter should be made with the patient in the proper position to outline the aorta to its greatest extent. This will usually be obtained when the patient is rotated clockwise from the usual posteroanterior position 35–60°, depending upon its appearance during the roentgenoscopic examination. The left clavicle is approximately parallel with the film in this position. Stereoscopic films would probably be an advantage.

DIAGNOSTIC FEATURES OF COARCTATION

Coarctation of the aorta has been thoroughly studied by the pathologists who have demonstrated the common characteristics of this anomaly These well-defined changes are such as to permit identification by modern roentgen technique. Given suitable opportunity to make a complete and satisfactory roentgen examination, it should be possible to establish the diagnosis upon the basis of these pathological changes.

These signs of coarctation may be conveniently divided into two general classes. (I) Direct signs—those relating directly to stenosis or atresia. (II) Indirect signs—those changes which give indirect evidence of obstruction such as the presence of a collateral circulation, cardiac hypertrophy and dilatation of the ascending aorta.

There are two primary signs: (1) Absence of the aortic knob in the posteroanterior chest film, and (2) defect or break in the continuity of the arch of the aorta at the descending limb in the left posteroanterior oblique chest film.

(1) *Absence of Aortic Knob in the Posteroanterior View.* The first of these has been noted previously by Abbott. The usual posteroanterior film of a normal adult chest shows a rounded eminence due to the aorta to the left of the spine at the level of the fifth dorsal vertebra. This becomes more prominent with age, and in later life may present a conspicuous knuckle or semicircular shadow projecting beyond the rest of the aorta, its prominence being greatly enhanced by the arteriosclerotic changes. This aortic knob, representing the junction of the transverse portion and descending limb of the arch, is absent in cases of coarctation because it represents the site of the isthmus which is the part of the arch involved by this anomaly.

The absence of the knob, therefore, in an adult, suggests a stenosis or atresia of the aorta and affords direct evidence which is sufficient in itself to lead to a complete cardiac roentgen study with oblique views, particularly the left posteroanterior oblique. In an elderly subject in whom a prominent knuckle would be expected, its complete absence should arouse immediate interest (Figs. 1 and 3). It was this latter finding in a man of fifty-seven which first

led us to suspect an anomaly of the aorta in our first case. It should be noted, however, that in early life this aortic shadow is normally absent or very inconspicuous. The sign is not pathognomonic and cannot be subjected to universal application. This change, however, was sufficient in a boy in his early teens (case of Hamilton and Abbott[5]) to be of aid in the diagnosis. It undoubtedly is a very valuable sign in adults.

(2) *Defect in Arch in Left Oblique View.* Cases published up to the present time which are accompanied by reproductions of the roentgenograms of the heart show that the films have been made in the conventional posteroanterior view.

A clear view of the arch of the aorta is necessary in order to study that portion of the arch which is involved in cases of stenosis or coarctation. The left posteroanterior oblique chest film, if technically satisfactory, shows practically the entire aortic arch. This view or the similar right anteroposterior oblique film should be obtained in every case in which a complete study of the heart and vessels is to be made. This view has been of particular interest for the study of other types of aortic disease such as arteriosclerosis, dilatation and aneurysm, but to our knowledge it has not been used in cases of coarctation, though its importance in such cases is manifest.

Coarctation will show a defect or break in the continuity of the aortic outline at the upper end of the descending limb of the arch. The defect is short in length (only 1–2 cm.) and anatomically located, in most cases, in that portion of the arch below the subclavian, at or slightly below the point of connection between the ductus arteriosus and the aorta. A complete stricture may not be evident for in many instances there is a narrowing or stenosis only. Abbott[1] in summarizing 200 cases, found only 47 completely atresic, while 108 were extremely stenotic and 45 moderately stenotic. A considerable column of blood must be passing through the stenotic section to permit the casting of an outline of it on the film. Cases of extreme stenosis or atresia will show little or no blood in the narrowed portion and hence, on the film, one notes a break in the continuity of the arch. In cases in which the stenosis is slight or moderate, an indentation of the arch will be observed which is usually sharply localized in the descending limb and the outline of the aorta comes to an abrupt ending. The indentation anatomically is usually more conspicuous on the convex side of the arch, and this is a fortunate circumstance, since roentgenographically the convexity of the arch in the oblique view is much more sharply delineated than its opposite margin.

A defect or break in the continuity of the arch in the region described is pathognomonic of coarctation. No other condition of which we are aware will produce this result. Arteriosclerosis, dilatation secondary to hypertension and aneurysm produce radically different shadows. These, particularly the last two, tend to accentuate or add to the aortic shadow. In a few rare congenital disorders, such as persistent truncus arteriosus and aortic atresia, the aorta may be absent or hypoplastic, but in these cases the defects or changes in the aorta are of a generalized or diffuse character and marked in degree. The localization of the defect in the descending limb of the aortic arch will serve to differentiate coarctation from the generally hypoplastic aorta in most instances. In approximately 10 per cent of the 200 cases collected by Abbott, the proximal aorta was somewhat narrower than normal, but in most of these cases the aorta was probably carrying a sufficiently heavy column of blood to permit outlining the arch up to the point of stenosis.

The left posteroanterior oblique film was of prime importance in establishing the diagnosis in both of our cases, the break in the continuity of the arch being evident in both (Figs. 5 and 6). The aorta of the

one which was examined post-mortem was completely atresic permitting the passage of no blood through the narrowed portion and ending as a blind pocket (Fig. 2). The loss of continuity of the arch in the film, therefore, finds a satisfactory anatomical basis. It is probable that the aorta of the other patient was similar to the first (either extreme stenosis or atresia), for the aortic arch could not be identified at its descending limb.

The great advantage of the oblique view is obvious in the study of coarctation in youth. The absence of the aortic knob in the posteroanterior film in youth is not a reliable sign because of its inconspicuous character in normal subjects, but the demonstration of a local defect in the oblique view makes the diagnosis certain. Satisfactory oblique films have been obtained in this clinic not only in children but even in infants.

Passing now to the secondary changes, evidence of which may be obtained from a study of the roentgenograms, there are three findings of importance: (1) Hypertrophy of the left ventricle; (2) dilatation of the proximal aorta, and (3) erosion of the ribs.

(1) *Left Ventricular Hypertrophy.* Cardiac hypertrophy, especially of the left ventricle, is commonly associated with coarctation, though it is not a necessary accompaniment even when the defect in the aorta is marked. Abbott[1] noted it in 75 per cent of all cases. Autopsied cases often show a dilatation or hypertrophy of other chambers of the heart which may be due to a superimposed endocarditis or to congestive failure. The latter is the commonest cause of death and results in the enlargement of both the right and left sides of the heart, though the enlargement of the left ventricle is more pronounced. Our first case showed, at autopsy, a particularly heavy, massive left ventricle, a dilated and hypertrophied left auricle, and moderate enlargement of the right auricle and ventricle. Extensive endocarditis about the aortic and tricuspid valves was also present. The origin, therefore, of the hypertrophy is often not simple nor due to a single cause, and the finding roentgenographically of a left ventricular hypertrophy is corroborative evidence only. For the determination of a left or right ventricular preponderance, the left posteroanterior oblique film is of much greater value than the usual posteroanterior view.

(2) *Dilatation of Proximal Aorta.* That portion of the aorta proximal to the stenosis is commonly dilated. In 101 of the 200 cases reviewed by Abbott, this dilatation was sufficient to be mentioned, while in only 28 cases was it noted to be hypoplastic or normal (hypoplastic, 21 cases; normal, 7 cases). Both of our cases show a dilated ascending aorta in the posteroanterior and left posteroanterior oblique views. It should be remembered, however, that in 10 per cent of Abbott's series the ascending aorta was hypoplastic, and this evidence or sign may be absent. When present, it indicates an intravascular hypertension proximal to the coarctation (probably associated with congenitally weakened arterial walls), and is often correlated with the clinical finding of high sphygmomanometer readings obtained from the upper extremities. The descending thoracic aorta immediately below the stenosis is often dilated, due to the return of the collateral circulation through the aortic intercostals. The descending aorta in our first case at autopsy appeared to carry a smaller volume than normal due to the extensive collateral circulation through the mammaries and hypogastrics, but it was difficult even on a review of the films to gain any definite roentgen evidence of this. Aneurysm, often of the dissecting type, is not an infrequent complication, usually involving the ascending aorta but was not noted in either of our cases.

(3) *Rib Erosion.* Rib erosion was first noted at autopsy by Meckel early in the nineteenth century. Cragie[4] (1841), in summarizing the literature, describes Mec-

kel's case including an illustration of the collateral circulation involving the upper intercostal arteries. These arteries are shown as greatly dilated tortuous vessels which have eroded the upper margins of several of the ribs in much the same manner as an aneurysm erodes bone (such as the spine and sternum). The finding of rib erosion, then, has been well known to pathologists for many years. Railsback and Dock[13] have recently shown that this rib erosion may be demonstrated roentgenographically. In fact, it was this finding which gave the clue to the diagnosis in their case. This erosion occurred along the lower margin of the ribs posteriorly and was bilateral. In both of our cases, this erosion could be identified. When the first case was interpreted the irregularities in one of the ribs was noted, but its significance was not appreciated. In the second case, the erosion of the ribs was definitely correlated with the collateral circulation. Our films were obtained with the anterior portion of the chest against the film so that the posterior ribs are not so well shown as the anterior ribs. In spite of this, all of the films show unmistakable evidence of costal erosion by blood vessel pressure.

The characteristics of these rib defects (Fig. 7) from a study of our films are as follows: (1) The defects are multiple, affecting more than one rib and not infrequently producing multiple defects of the same rib. (2) They are bilateral, affecting particularly the posterior portions of the ribs. (3) The lower margin of the rib only is affected. (4) The sulcation is smoothly curvilinear, never angulated or rough. (5) Simple erosion of the rib occurs where it is in contact with the artery without any alteration in bone trabeculation or other evidence of pathological change elsewhere in the rib. (6) New bone formation is essentially absent, though occasionally the sulcated margin may be brought out into striking relief by a smooth line of increased density in the deeper portion of the sulcation. (7) Pathological fracture has not been noted, though erosion may involve half of the diameter of the rib or more.

There is very little likelihood of these being confused with other defects of ribs. It should be remembered that the first pair of ribs normally possess a separate groove for the subclavian artery and vein, and some films show these grooves prominently. However, these grooves affect the anterior portion of the ribs on their superior aspect and of course will not be noted below the first rib. Occasionally an aneurysm may erode ribs but these defects will be sharply circumscribed and limited to the site of the aneurysm; the involvement is practically never diffuse or bilateral. A mediastinal tumor may by its growth produce obstruction, but this is usually to the venous return and the collateral circulation which commonly results

Fig. 7. Case II. Reproduction to show the local erosion of two ribs of left posterior thorax.

affects the veins of the thorax rather than the arteries. These dilated veins do not erode bone. Traumatic deformities and congenital anomalies offer no opportunity for confusion.

Rib erosion, though a secondary manifestation of coarctation, is practically pathognomonic of it. Not every case of coarctation, however, will show a collateral circulation. This will depend to a large extent upon the degree of the stenosis and in part on its duration, i.e., the patient's age. The actual incidence of a collateral circulation is difficult to determine from autopsy statistics because very often no mention of either its presence or absence is made. Blackford states that he was able to find only 8 cases in which no such circulation was found, when a search was made. A latent case without a collateral circulation has been recently described by Sala and Nachamie[14] in an infant of six months, dying of bronchopneumonia. Occasionally an adult may fail to show a collateral circulation, but in this type of case the stenosis is usually mild in degree and the passage of blood through the stenosed portion is adequate without the establishment of an auxiliary circulation. Such an individual is usually free of symptoms and the recognition of the anomaly is not so important as in those showing a more marked stenosis.

The extent of rib erosion will also depend on the course of the collateral circulation, being present only in those cases in which the aortic intercostals are involved. The collateral circulation is commonly between the superior intercostal (branch of the subclavian artery) and the first aortic intercostals, and also between the scapular branches of the thyreo-cervical trunk of the subclavian and the aortic intercostals. Less often or to a less extent the anastomosis between the internal mammary artery (branch of subclavian) and the inferior epigastric artery (branch of external iliac) is developed. The flow through the latter route will not produce rib erosion. It is interesting to note that in our autopsied case there was a marked collateral circulation through this route but nevertheless the collateral through the aortic intercostals was sufficient to produce numerous defects of the ribs. It is possible too for the intercostal branches of the internal mammary to form a collateral circulation with the aortic intercostals. In this event one might expect erosion of both the anterior and posterior portions of the ribs. Such a case has not been noted up to the present time.

Rib erosion therefore will not be found in every case of coarctation but will be commonly seen in those cases in which a considerable collateral circulation has been established through the aortic intercostals. When present in characteristic fashion it alone is sufficient to make the diagnosis certain; when absent, coarctation cannot be ruled out without demonstrating an intact aortic arch in the left oblique view.

With these features in mind, the diagnosis of coarctation will not be a difficult matter and there will be but little opportunity for confusion with other disorders. In tumors one may demonstrate a mediastinal mass, an intact arch, and the absence of rib erosion. Aneurysm may occur in cases of coarctation so that the demonstration of an aneurysmal mass of course in no way rules out the additional possibility of coarctation. Aneurysms without coarctation do not produce rib erosion except locally at the site of the mass, and a sufficient collateral circulation is not established. In rare instances a generalized hypoplasia of the aorta may occur, such as the case recently described by Philpott[11] which was associated with a persistent thymus and lymphoid hyperplasia. Such a case would be expected to show an aorta of small diameter throughout and will lack the characteristic signs of coarctation. Rare congenital defects such as truncus arteriosus may show an anomalous course of the common vessel and it would then be impossible to outline the aorta and the pulmonary artery as separate vessels aris-

ing from the heart. Rib erosion would not be expected.

There are several criteria which might be used to differentiate the infantile type of coarctation from the adult type. In the infantile type, which occurs practically entirely in still-born or young infants, there is usually a diffuse narrowing of the aorta which extends for a considerable distance proximal to the patent ductus and therefore the defect differs in character and location; the pulmonary artery is much dilated and there is no collateral circulation.

SUMMARY

A review of the diagnostic features of coarctation reveals two findings which may be considered pathognomonic, a defect in continuity of the arch at the junction of the transverse and descending portions of the aortic arch outlined in the left posteroanterior oblique film, and rib erosions which may be identified in either the oblique or posteroanterior views. Rib erosion, when present, may be considered practically pathognomonic, in spite of the fact that the sign is of an indirect character, for it demonstrates the presence of a collateral circulation due to the obstruction. This is not noted in other conditions except under the rarest of circumstances, and in these rare cases rib erosion has not been described, probably because the process is too acute or rapidly progressive.

There are sufficient data in the literature to show, however, that the absence of rib erosion does not rule out a coarctation, for no collateral circulation may be present or, if present, it may not involve the intercostal arteries to a sufficient degree to produce erosion of bone. The demonstration of a characteristic defect in the arch in the oblique view becomes therefore the most reliable single finding in coarctation and can be demonstrated in all cases where it is possible to secure a satisfactory left oblique posteroanterior film.

The other common findings in coarctation are suggestive or corroborative only. The absence of the aortic knob in the usual posteroanterior film is highly significant in an adult and such a finding should lead to a complete cardiac study in which special emphasis should be placed on the appearance of the aortic arch in the left oblique posteroanterior view. It is quite probable that the presence of a definite aortic knob in the posteroanterior view is more conclusive evidence of the absence of coarctation than is its absence in ruling it out. A left ventricular hypertrophy and a dilatation of the proximal aorta, which are also usually present in these cases, are noted commonly in various other cardiovascular disorders. This evidence is suggestive or confirmatory only.

It will be noted from this study that the left posteroanterior oblique view of the chest is of greater importance than the usual posteroanterior view. It will actually yield more positive and definite information. Thus, four out of the five roentgenologic features, the defect in the arch, rib erosion (pathognomonic evidence), as well as the demonstration of left ventricular hypertrophy and dilated proximal aorta, can be determined in the oblique view, and of these four at least three are seen to better advantage or can be recognized with greater certainty in the oblique view: the defect in the arch, the left ventricular hypertrophy and the aortic dilatation. Absence of the aortic knob, the finding which is to be noted only in the posteroanterior and anteroposterior films finds its more reliable equivalent in the defect in the arch in the oblique film.

CONCLUSIONS

1. The roentgen findings in coarctation of the aorta (adult type) are sufficiently definite and characteristic to establish the diagnosis by this means alone.

2. A simple roentgen technique consisting of a roentgenoscopic examination, a posteroanterior film and a left postero-

anterior oblique film is sufficient to establish the diagnosis.

3. The direct roentgen signs of coarctation relate to the defect in the aortic arch in the posteroanterior and left anterior oblique views.

4. The indirect signs, left ventricular hypertrophy and dilatation of the ascending aorta, relate to the obstruction of the blood flow through the aorta and the rib erosion to the collateral circulation which results from such obstruction.

5. Of these findings, two are of the greatest importance, the direct sign of the defect in the arch and the indirect sign of rib erosion.

6. Two cases of coarctation are described which illustrate all the roentgenologic features necessary for the establishment of the diagnosis.*

Later Note. Since completing this article, through the kindness of Dr. John T. King of Baltimore, we have had the opportunity to examine prints of films of 4 cases of coarctation, 3 of which Dr. King has reported as coarctations, the fourth case being one first diagnosed as coarctation by Dr. Milton B. Kirsh and subsequently seen by Dr. King. The films were of great interest to us in showing a cardiovascular shadow similar in type to those of our cases. Three out of the 4 cases show unmistakable evidence of rib erosion. Dr. Kirsh's case was particularly instructive since this one was followed during youth over a period of seven years by films (age period 10–17 years). Films obtained at ten and twelve years show no notching of the ribs, while at seventeen years notching has begun. Dr. King, in a personal communication, notes that the most marked erosion was in the oldest patient and the least in the youngest. This is in agreement with the impression we had gained that erosion of ribs is dependent in part on the length of time the condition has been present, i.e., the patient's age.

This suggests that rib erosion (like the absence of the aortic knob) is probably not a reliable sign in youth, and to establish the diagnosis roentgenologically main reliance must be placed on the direct sign of the defect in the arch in the left oblique view.

* The writer wishes to express his thanks to Dr. G. H. Whipple for permission to include his autopsy findings of one of the cases reported. To Dr. S. L. Warren he is greatly indebted for many helpful suggestions and aid in the preparation of the manuscript.

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AMNIOGRAPHY

PRELIMINARY REPORT

By THOMAS O. MENEES, M.D., J. DUANE MILLER, M.D., *and* LELAND E. HOLLY, M.D.
Blodgett Memorial Hospital
GRAND RAPIDS, MICHIGAN

OBSTETRIC roentgenography has been limited almost entirely to a demonstration of the fetal bones and uterine contour. Occasionally, when the subcutaneous fat of the fetus is unusually thick, the outline of an extremity is obtained. The slight difference in density of fat and liquor amnii is sufficient to cast a shadow. This suggested an artificial increase in density of the amniotic fluid to give contrast to fetal soft parts and placenta. Amniography is proposed as a name for this procedure, differentiating it from uterography, the roentgenography of the non-pregnant uterus.

This contrast is obtained by the injection of a one to one solution of U.S.P. strontium iodide through the anterior abdominal wall. The actual concentration is about 0.75 gm. per c.c., as strontium iodide contains six molecules of water of crystallization. After anesthetizing the skin with novocaine, a small flexible lumbar puncture needle is passed into the amniotic cavity, usually below the umbilicus and near the midline. The puncture is made on the side with the fetal small parts. After obtaining fluid through the needle, the injection is made slowly with frequent withdrawals of amniotic fluid to dilute the solution. Following injection, it is advisable to wait half an hour to an hour before taking the films, to permit an even diffusion throughout the amniotic

FIG. 1. Posteroanterior film and tracing showing the fetal small parts well outlined. Several loops of cord are visible. The breech shows no projecting shadow of scrotum, justifying a diagnosis of female fetus. The fetal stomach contains strontium iodide.

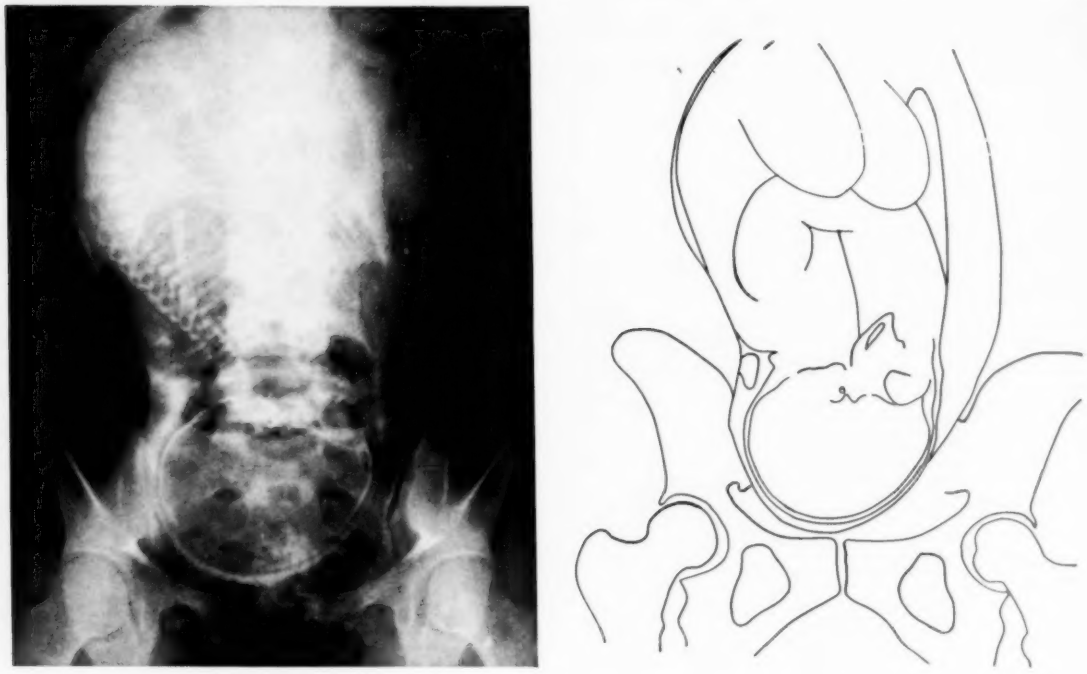

Fig. 2. Posteroanterior film and tracing showing a flattening of the left margin of the uterus, probably due to placenta. The cord is shown encircling the fetal neck.

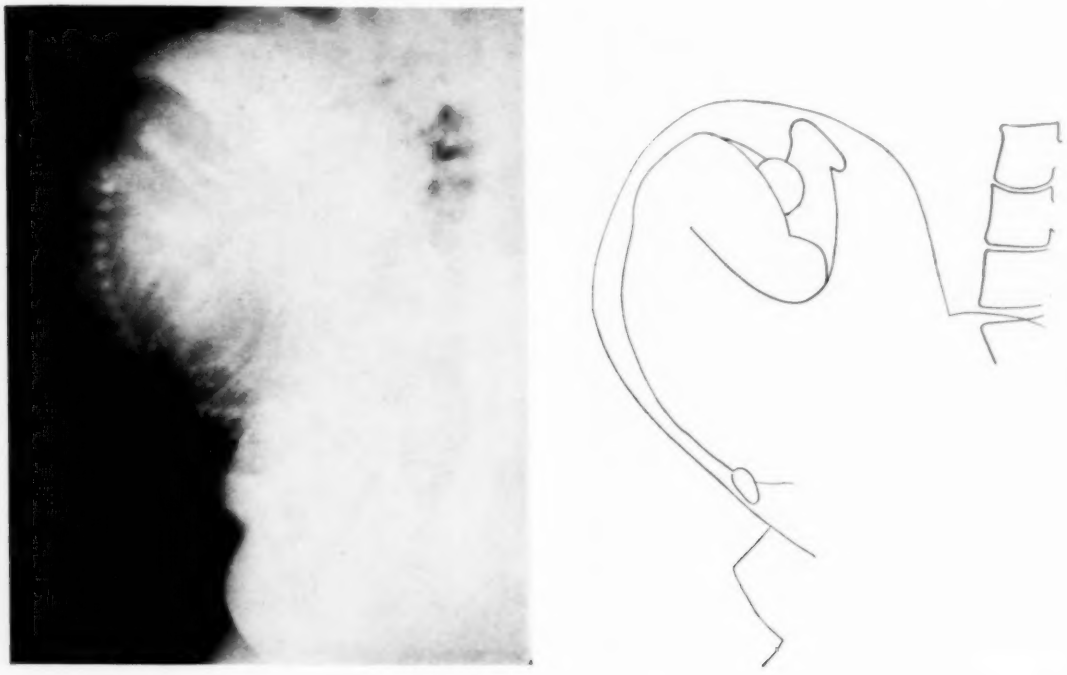

Fig. 3. Lateral film and tracing showing the breech well outlined. A rounded projection from this was interpreted as scrotum justifying a diagnosis of male fetus. The cord is shown about the fetal neck.

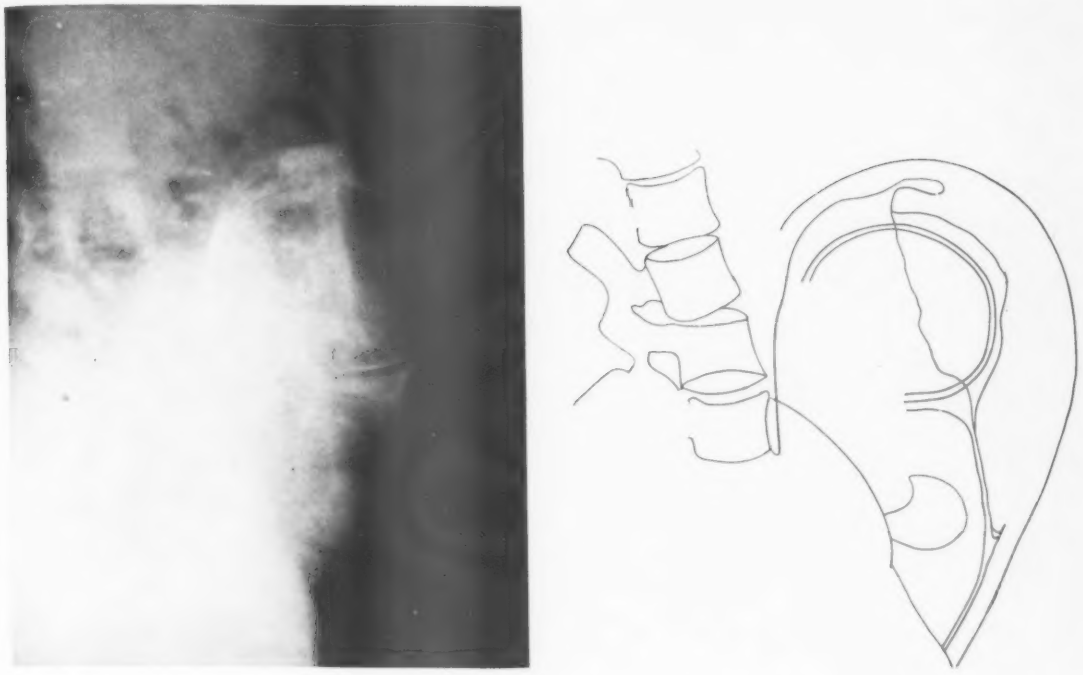

Fig. 4. Lateral film and tracing showing the placenta occupying the anterior portion of the fundus. The fetal stomach contains strontium iodide.

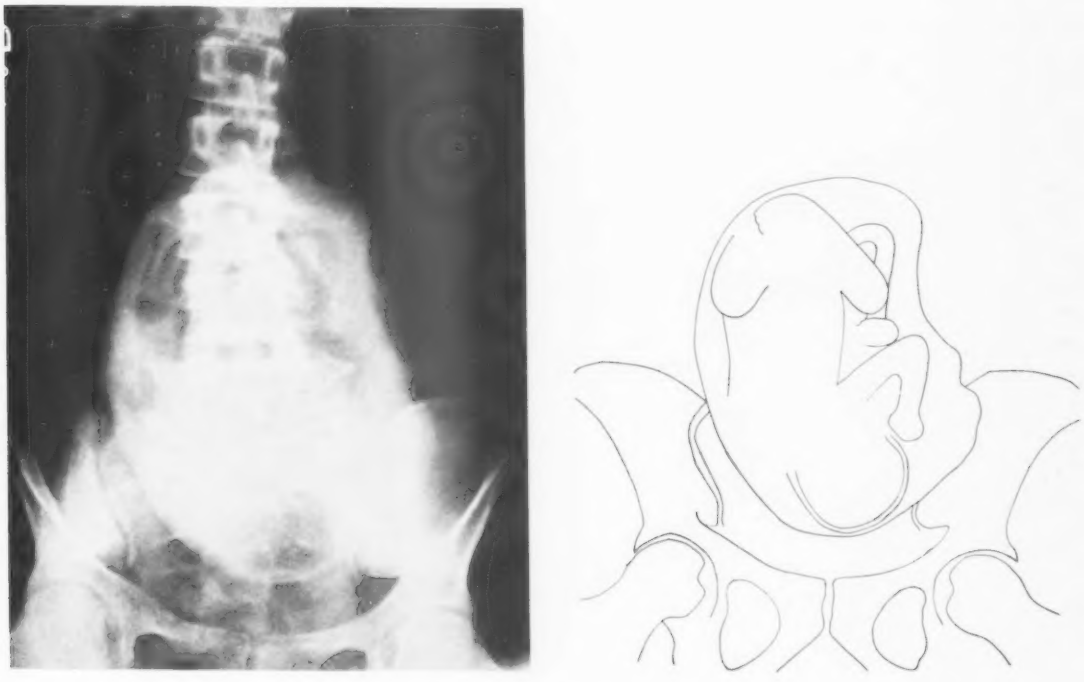

Fig. 5. Posteroanterior film and tracing showing a distinct outline of fetal small parts. The placenta extends backward to the left side of the uterus producing an irregularity in the amniotic contour.

cavity. During this time the patient changes position frequently to assist in the mixing. The exposures are made on a Potter-Bucky diaphragm, using a high milliamperage and relatively low voltage to insure a maximum contrast.

The correct amount of solution to inject is difficult to estimate. It varies with the quantity of liquor amnii present and this is almost impossible to determine in advance. If too much solution is injected, the whole interior of the uterus will become opaque and the object of the examination will be defeated. From 7.5 to 15 c.c. of the solution have been used. The larger amounts caused too much opacity and probably 9 or 10 c.c. will be sufficient for the average case in the latter months of pregnancy.

In the 21 cases injected there have been no injurious or toxic effects to the mother or fetus in normal pregnancies. In a case of placenta praevia, at the sixth month, the fetus was expelled about thirty hours after injection. The cord was pulsating and the fetus made a few feeble attempts at respiration. The placenta showed a partial separation. It was located low on the anterior wall and may have been perforated in the injection. The pulsating cord excluded any toxic effect to the fetus.

These films have shown the location of the placenta in the majority of cases. The placenta appeared as a filling defect or a flattened area, best seen when caught in profile. Probably the failures to show the placenta were due to the fact that it was not projected in profile on the usual posteroanterior and lateral views. Under these circumstances oblique views are of help. The cord, encircling the fetal neck has been shown twice. Sex has been determined four times, three males and one female. A true lateral view of the breech is necessary for this, and this happens rather rarely.

A shadow in the region of the left costal margin of the fetus has been present on a large percentage of films. This has been interpreted as strontium solution in the fetal stomach, indicating that the swallowing of amniotic fluid must be of frequent occurrence.

The rate of absorption of strontium iodide was surprisingly rapid. Films taken four or five hours after injection showed an appreciable decrease in the density of the shadow. The fetal contours were lost at about twenty-four hours, showing that most of the salt had been absorbed by this time.*

SUMMARY

A method is described for visualizing fetal soft parts, localizing the placenta, and occasionally determining sex. It may be of value in the diagnosis of placenta praevia and determining the exact relation of the placenta to the cervical canal.

* We wish to acknowledge our indebtedness to Drs. Joe De Pree, A. M. Campbell, and J. D. Hastie for assistance and encouragement in this work.

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THE DIAGNOSIS OF EARLY ILEOCECAL TUBERCULOSIS

A PRELIMINARY REPORT WITH SPECIAL REFERENCE TO THE DOUBLE CONTRAST ENEMA

By J. GERSHON-COHEN, M.D.

Instructor in Roentgenology, Graduate School of Medicine, University of Pennsylvania; Roentgenologist to Eagleville Sanatorium, Eagleville, Pa.

PHILADELPHIA, PENNSYLVANIA

THE diagnosis of early ileocecal tuberculosis is at present made by the roentgen examination alone, the time having passed when this disease could be diagnosed clinically only in the later stages and then invariably fatally prognosticated. The veracity of these claims have been amply developed by able workers in this field.

Stierlin,[24] in 1911, published an excellent article on the roentgen diagnosis of tuberculous ulceration of the colon and described many of the phenomena on which the modern interpretation is based. It was probably because he failed to call more commanding attention to the crucial diagnostic test, namely, hypermotility of the barium meal through the affected segment of colon, that the real significance of his work in the diagnosis of early colonic tuberculosis went so long generally unrecognized by such investigators as Case,[7] Béclère and Mériel,[3] Kienböck,[15] Bandelier and Roepke,[2] Faulhaber,[9] Révész,[19] François,[13] Sigmund,[23] Carman,[5] Schlesinger,[22] Flemming Møller,[12] and others, all of whom could corroborate his findings in only a very limited number of cases or entirely disagreed with the diagnostic value of his findings. Pirie[18] called attention to this phase of the roentgen examination in 1915, but it remained for Brown and Sampson[4] to elaborate and convincingly demonstrate by the use of the barium meal, the accuracy and reliability of the roentgen examination in the diagnosis of early tuberculosis of the colon, by elaboration of Stierlin's phenomena. They have extensively and most thoroughly studied this subject and have developed an excellent technique of examination with the barium meal. They place great reliance on the opaque ingested meal method for filling the segments of the intestinal tract to be studied, making serial roentgenoscopic and roentgenographic examinations at regular intervals from the seventh to the tenth hour after the ingestion of the meal. The "filling defects" in

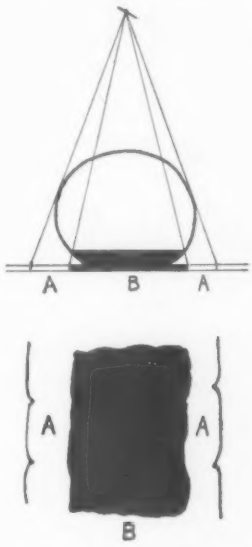


FIG. 1. Patient in supine recumbent position and the roentgen rays directed vertically. A. The upper layer of air is projected to the sides of B. Dependent layer of residual contents. In the roentgenograms, the intraluminal processes are thus visible in the projected column of air in the peripheral zones of the colon whose walls are coated with the opaque barium mixture. This position, although it affords visualization of smaller sectors of air-filled barium-coated colon, has been found most generally satisfactory because the entire length of the colon can be studied at once and necessitates but one exposure. The other supplementary positions, as shown in Figures 2 and 3 can be used when indicated.

the ascending colon which must be constant in all or most of the serial roentgenograms and which are due to spasm, irritability and hypermotility of the opaque

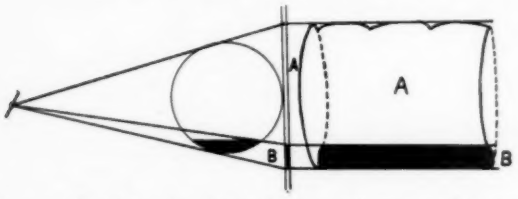


Fig. 2. Patient in lateral recumbent position—horizontally directed roentgen rays. Projection of large air sector of barium-coated bowel above dependent small sector of residual barium-containing bowel.

contents through the affected segments, are the signs carrying the greatest weight in the diagnosis. They fully describe the variations of these phenomena and stress these functional changes as being the only roentgen evidence in early tuberculosis of the colon. The enema study of the colon is believed by them, however, to be definitely less reliable in the demonstration of these phenomena. They regard spasm of the colon during the enema study as not necessarily unnatural and therefore not sufficiently diagnostic of pathological changes, and claim further that a segment of colon which cannot be filled with the ingested meal (resulting in "filling defects") is in an entirely different state from one which fills and contracts or "spasms" during the enema examination. Yet they believe spasm that is limited to the cecum, more significant and go on to say that with the enema when, as observed in tuberculous colitis, the cecum or ascending colon repeatedly fills and empties, this finding is of extreme importance. Examination of their tables also reveals the fact that in their cases which revealed positive evidence of tuberculosis of the colon with the barium meal, the enema also yielded positive findings in practically all of the cases studied by both methods. It seemed, therefore, that their investigations were unwarrantedly prejudiced against the use of the enema examination which has many advantages over the barium meal technique. The enema examination can be done with greater dispatch, the patient need be brought to the roentgen department only once, it furnishes all the information obtainable with the barium meal and, in addition, eliminates very frequently the difficulty often encountered in the interpretation of the "filling defects" of the serial roentgenogram which are not true filling defects, but ever changing contours and irregular outlines of a segment of colon through which there is hypermotility, due to irritability, hyperperistalsis and spasm.

Realizing these advantages and the potential possibilities of the double contrast air-barium enema studies of Fischer,[10] we developed a technique of examination that has made possible an earlier and more reliable diagnosis of ileocecal tuberculosis than with the barium meal method. These studies were made on 138 cases of pulmonary tuberculosis at Eagleville Sanatorium, most of the patients coming from the service of Dr. A. J. Cohen, all having tubercle bacilli in the sputum and all patients examined clinically and especially for this analysis by Dr. Louis Cohen. Forty-two cases revealed positive evidence

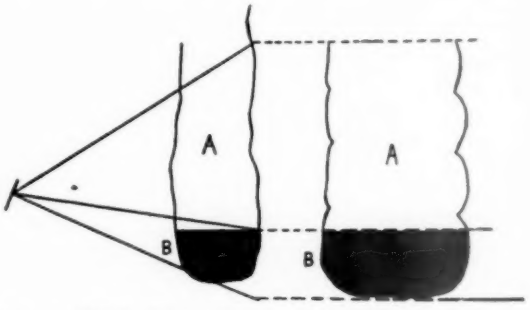
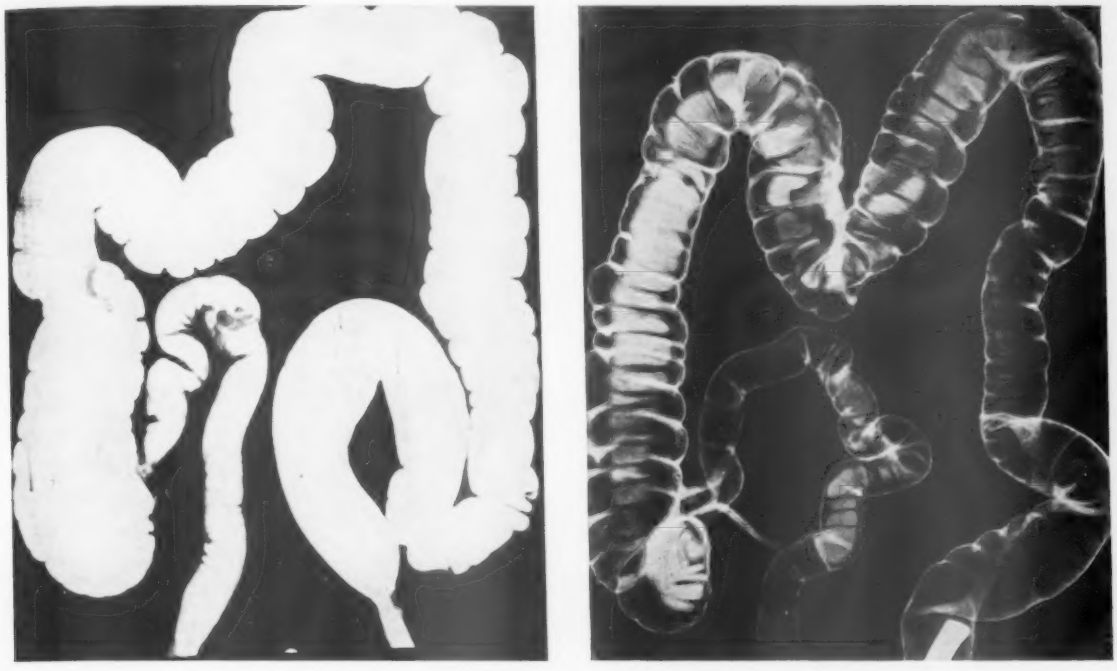


Fig. 3. With the patient in the erect position, the roentgen rays directed horizontally project the colonic outline with the air column above the dependent layer of residual contents. A. Air in barium-coated colon alone. B. Residual column of barium. This position is best in studying those portions of the colon that take a transverse direction, namely, the transverse colon, portions of the sigmoid and redundant parts of the ascending and descending colon.



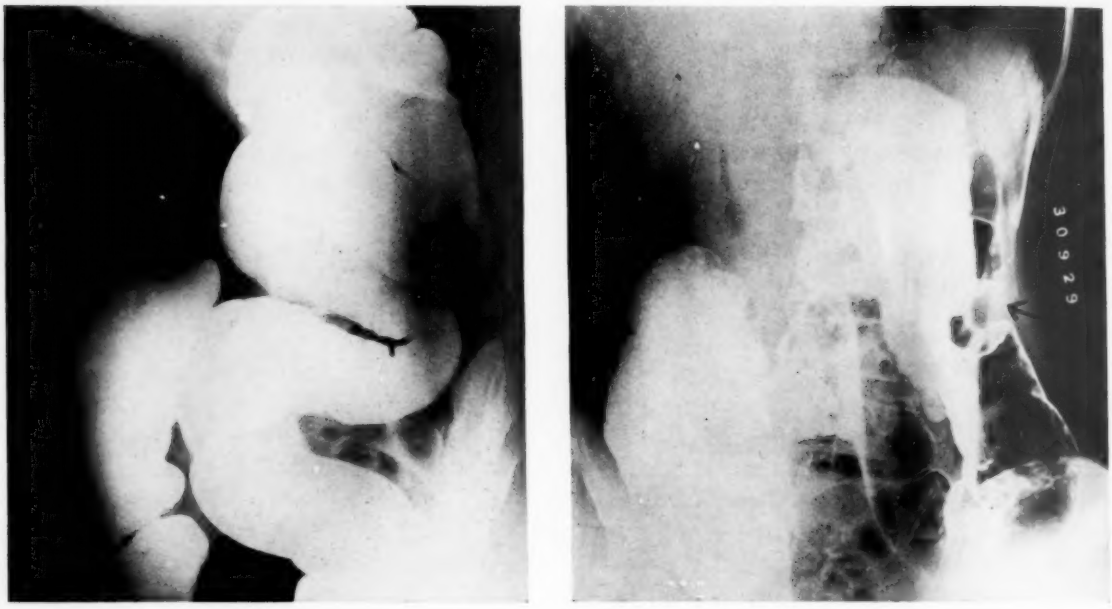
A B

Fig. 4. A. Single contrast enema. B. Double contrast enema. Note in the double contrast enema how clearly and easily the intraluminal surfaces and haustral markings are seen throughout the entire length of the colon. The colon, which has been removed from the cadaver, has been placed flat on the table and the roentgen rays directed vertically so that the air column has been projected to either side of the residual, centrally dependent barium contents.

of ileocecal tuberculosis. Thirty-one cases also had routine roentgenographic studies of the entire gastrointestinal tract incorporating the Brown-Sampson technique of colonic examination. These cases were thus studied not only to check the findings as revealed by enema examinations, but to study what diagnostic advantages whether complementary or supplementary, one method had as compared to the other. Dr. Harry Shay also made thorough clinical and laboratory gastroenterologic studies on this group. Sixteen cases of this smaller group were found to have ileocecal tuberculosis, one in the first stage, 6 in the second stage and 9 in the third stage. The diagnosis was suspected clinically in 7 of these cases, but in all of these 16 cases Dr. Shay made a constant finding in the microscopic examination of the feces, which he is reporting elsewhere. Both the barium meal and enema studies revealed positive evidence of ileocecal tuberculosis in these 16 cases, but of those studied by the enema method alone, 26 additional cases were positive. The evidence furnished by the enema studies gave us a better concept of the extent and intensity of the infection than did the barium meal serialographic examinations, but the latter, nevertheless, yielded useful confirmatory evidence. A statistical analysis is not included here since these combined studies are still being pursued at Eagleville, and this report is intended to set forth only the technique and exposition of the value of the "double contrast colographic" studies of ileocecal tuberculosis.

TECHNIQUE

Without special preparation, an opaque mixture, such as is generally in common



A B

FIG. 5. Small adenocarcinoma of descending colon almost completely obscured in single contrast enema examination. A. Even though patient has been rotated to show defect best. B. The tumor is very clearly demonstrable in double contrast enema roentgenograms, with patient in the right lateral recumbent position, roentgen rays horizontally directed. (Diagnosis confirmed at operation and histological examination, from the service of Drs. H. L. Bockus and William Bates, at the Graduate Hospital, Philadelphia.)

use, is first injected into the colon under roentgenoscopic control and the usual observations made, paying special attention to spasm and irritability of the colon, particularly on the right side, mass peristalsis, anastalsis, competency of the ileocecal valve, the outline of the colon, ileocecal valve and terminal ileum, the presence or absence of pain and tenderness over any segment of colon, the distribution, form, balancing and the peristaltic changes of the haustra, the mobility of the cecum and ascending colon and the constancy of any irregularities or defects in the colonic outline. A roentgenographic examination is then made and the patient permitted to evacuate the opaque contents. This is followed by another *intermediary roentgenoscopic examination* at which time the distribution of the residual contents is carefully noted. Mass peristalsis of a residual column in any colonic segment is looked for at this time, either that which may occur spontaneously or after palpation. Air is then inflated into the colon using a Pulitzer bag with a ball-valve, the bag being attached to an 18 inch length of rubber tubing and held above the level of the abdomen. This is done slowly under roentgenoscopic control and is stopped when the colon is filled. No pain is experienced by the patient if this is done slowly. The roentgenoscopic examination, as with the single contrast, enema, is again made and is followed by roentgenographic studies with the patient in the supine position and the roentgen rays directed vertically (Figs. 1 to 5).

THE DOUBLE CONTRAST ENEMA ROENTGENOGRAMS

The difference in shadow densities in a roentgenogram form the real basis for roentgen diagnosis, and the inflation of air into canals or hollow viscera in order to supply a good contrast medium is not a

new procedure. This idea is now commonly employed in ventriculography and encephalography, one of the greatest recent advances in the roentgen diagnosis of brain lesions. The same idea was employed long ago by Cole and Einhorn,[8] Pfahler[16,17] Schittenhelm,[21] Röpke,[20] and others, when they inflated air into the colon to outline intraabdominal tumors, the lower border of the liver and spleen, or air into the bladder to more clearly demonstrate intravesical growths, or when they inflated air into the stomach either with the tube or by the use of effervescent powders to reveal its outline and intraluminal contents. These latter procedures were definite steps forward, but their routine use has been abandoned probably because insufficient contrast of densities was obtained, resulting in difficulties of interpretation due to overlapping of the air-filled coils of colon and ileum and the indistinctness in outline of many of the air-inflated segments. The double contrast air barium roentgenograms of the colon, however, make the utmost use of differences in medium densities; that is, air against the barium-coated colonic mucosa. This strong contrast of densities naturally leads to greater accuracy in the visualization of pathological processes, the coating on the air-containing walls making them stand out in more marked contrast. Intraluminal lesions then become visible which otherwise would be hidden and obscured in the single contrast medium, and the entire length of the colon can be traced no matter how much overlapping, redundancy and reduplication there may be.

The double contrast enema serves other useful purposes in the study of ileocecal tuberculosis. It becomes a check on the findings of the single contrast enema. Thus, irregularities in outline or defects in contour due to spasm, incomplete filling with the single contrast medium or retained fecal material, being absent in the double contrast roentgenograms, no longer confuse the interpretation. If the same irregularities of outline, however, are seen in both the single and double contrast roentgenograms, then their true significance may become immediately manifest; but in the double contrast films a better concept of the nature and extent of the pathological change is obtained because of the greater and clearer visibility resulting from the more marked contrast between the barium-coated mucosa and the enveloped air.

When we first began using these double media, we were so impressed with the many new fine details of structure that were visible, that we thought this method might even be used to demonstrate the small early tuberculous ulcer itself. Various changes in the constituents of the opaque mixture were made by the addition of acacia, tragacanth, olive oil, glycerin, various pastes of flour, etc., with the hope that a selective adherence to the ulcerated margin or surface would follow with a greater residual deposit on the lesion than on the normal surrounding mucosa. We found, however, that there was practically no difference in any of these mixtures, even when we used tuberculous colons removed from the cadaver for this experimentation. Although ulcers could be seen in the double contrast films of these excised colons because of the slightly greater accumulation of barium suspension on and under the margins and over the necrotic surface of the ulcer, we were never able to see them, except in occasional instances, in the roentgenograms of patients with colonic tuberculosis. This, of course, is due to the secondary radiation from the surroundng tissues which is just sufficient in most instances to obscure these fine linear deposits.

Many additional details of the lesions in both the ulcerative and hyperplastic types of colonic tuberculosis are visible in the double contrast roentgenograms that are completely absent in the single contrast films and not even suggested in the serialograms with the barium meal. Hyperplastic ulcers with small, fine, irregular lakes of residual barium in their interstices, fine and coarse contracting fibrous bands, the

ulcerated margins of the ileocecal orifice with the attendant changes in its size and shape, excessive mucus with its impregnated barium sharply visible in its flaky or stringy distribution in the colonic air column, necrosing sloughs, clinging with their streaky irregular deposits of barium to the colonic walls, are some of the many fine details that can be seen only in the double contrast films, making possible a more accurate interpretation of the type, extent and severity of the tuberculous process.

Our diagnosis therefore of early ileocecal tuberculosis is no longer limited to the major phenomenon of splitting of the barium meal column by and through the affected segment resulting in "filling defects" often defying correct interpretation and furnishing us with misleading concepts concerning the anatomico-pathologic changes. The single contrast enema completely fills the colon and since this must first be done in order to complete the double contrast study, the findings of one can be checked against those of the other. The intermediary examination between the enema studies is also used for checking the phenomena of motility, spasm and mass peristalsis, and proves of inestimable value in the diagnosis of early ileocecal tuberculosis when these functional phenomena are the only signs obtainable. With all these new roentgen signs thus available, we believe that the different stages of the tuberculous processes are definitely demonstrable by characteristic roentgen signs and so we have classified them into three stages.

PATHOLOGY

Tuberculosis of the intestinal tract may be acute or chronic and run a short fulminating or a long drawn out course. The infection may be limited to the small bowel, usually the ileum, or to the cecum, or ileocecal region or extend through the ileum, jejunum and colon, even to the rectum. The infection may be very limited or scattered widely in isolated areas or involve almost uniformly long segments of the terminal ileum and cecocolon. It is, therefore, like pulmonary tuberculosis, in that it also has a favorite site of initial infection and variations in its characteristics resulting from differences in the quantitative degrees of infection, extent of involvement and types of tissue reactions, all of these factors entering into the different classifications of the disease.

The favorite site for tuberculosis of the intestinal tract in the adult is the terminal ileum; next the cecum, and with decreasing frequency from these locations, into the jejunum and distally into the transverse and descending colon. Tubercles first develop either in very limited numbers or in greater abundance in Peyer's patches or in the lymphoid collections in the cecum. These areas are the commonest initial sites of infection because the ingesta after passing rapidly through the jejunum is delayed again for a longer time in this region. This retention in the ileocecal area, whether it be for the completion of digestion or for certain processes of assimilation, or for both, allows contact of the mucosa with the infective ingested contents for a longer period than elsewhere in the intestinal tract and thus accounts for this localization of the process in the greatest majority of cases. Nonspecific enterocolitis, frequently complicating pulmonary tuberculosis, the result of forced feeding with high caloric diets, often not ideally balanced and changed, with enforced rest and insufficient exercise, is also probably a contributing cause for this characteristic localization of the infection. Thus the combined unfortunate circumstances of a mildly inflamed intestinal tract with continued or repeated exposure to infective ingesta, are all too frequently seen in active cases of pulmonary tuberculosis.

In the first or earliest stage, tubercles will form, possibly simultaneously over a wide area or first in one localized region and later in other distant segments. In the

beginning, they may be miliary or larger in size and form gray, projecting, translucent nodules of different sizes. The mucous membrane over such nodules is often reddened, turgid and injected. Accompanying the purely proliferative reaction to the tubercle bacillus (as seen histologically), is a low grade inflammation consisting of some transudation of serum and a few red and white blood cells. Inspissation or even calcification may ensue at this phase, but what is more usual, necrosis of the mucous membrane over the apices of the nodules follows, forming crater-like superficial ulcers, from which a discharge of yellow, caseous, or greenish tuberculous matter may take place. Necrosis of the entire mucous membrane for a considerable distance on each side of the erupted caseous focus usually takes place. The edges of these ulcers are flaccid and undermined. About this time also, inflammatory edema of the nerve sheaths, as well as perineural and periganglionic round cell infiltration is seen.[1] Whether these changes in Auerbach's plexus are the sole cause of the increased tone and peristalsis of the affected segments or whether the catarrhal inflammation over wide areas of the mucosa, often concurrent with tuberculous infection, also plays a contributing part, has not yet been definitely determined. Under favorable conditions of natural resistance and with institution of the proper modern therapeutic measures, this initial stage may go no further, the healing processes arresting the progress of the disease.

The second or moderately advanced stage begins when these small isolated ulcers and nodules further spread and break down. The small ulcers may grow larger and coalesce with other nearby ulcers, forming thickened, infiltrated, everted, gnawed or undermined edges with their bases limited by a granulating or caseous submucosa or muscularis. These ulcers may extend widely and superficially in all directions or they may extend deeply into the muscularis with the formation of tuberculous granulations around the edges and a gelatinous layer of caseous matter on the surface of the ulcer itself. Lymphatic extension is now more marked and nodules may form, often in great numbers, about the periphery of these ulcers, new tuberculous foci thus springing up nearby.

The third or advanced stage is ushered in with the further spread of these ulcerative processes, extending over wide areas from the ileocecal region back into the jejunum and forward into the distal portions of the colon. The ulceration may still remain superficial, with extensive uniform fibrosis in the submucosa and muscularis having progressed steadily forward. Extensive areas of slough and even false diphtheritic membranes may form. The walls of the ileum and cecocolon become smooth and rigid with rather uniform contraction of the lumen. On the other hand, the deep ulcers which showed less tendency to superficial extension, may excite very considerable and localized hyperplasia of fibrous tissues, forming irregular, jagged, projecting tumefactions of granulating hyperplastic tissue, occluding the lumen. Many remissions and exacerbations take place in the progress of the disease during the second and third stages of the disease and may even result in healing, on the one hand, or otherwise go on to a fatal termination.

All these pathological changes can be demonstrated by roentgen signs revealed in the enema studies as we have applied them. Although the tubercle and the first and earliest tuberculous ulcers themselves cannot be demonstrated, except in rare instances, yet their presence is indicated by the functional changes of increased tone, spasm, hyperperistalsis and hypermotility, excess exudation, etc., which the affected segments display during the different phases of the enema studies.

Fig. 6a. Spasm of cecum and upper ascending colon in single contrast enema.

ROENTGEN SIGNS

Stage I. Earliest Phases.

1. *Spasm.* Temporary tonic spasm, too long delayed, or intermittent spastic contraction occurring too frequently, is probably one of the earliest manifestations of irritability, associated with inflammation of an affected segment of colon. Colonic spasm of a segment of ascending colon naturally is more significant than in the more distal segments, since tuberculosis affects this side in the greatest majority of cases. Tonic contraction of the cecocolon may already be present before the head of the injected column reaches it, thus preventing its entrance. Spastic contraction of the cecum may follow only after it has been almost filled and then be followed by tonic spasm in other segments of the ascending colon. These spasms may be of short duration, but the periods of relaxation followed by complete filling, will often be shorter. At times, the spasms may be so tonic as to persist during almost the entire examination. On the other hand, it may be so latent that it is only seen after palpation or after evacuation during the intermediary or double contrast air insufflation examinations. Spasm may be seen in only one of the enema examinations, but this is rare and when it occurs without other signs should be guardedly interpreted since extra colonic lesions, like subhepatic, perirenal or pericecal abscesses, or appendicitis, may cause similar spasm. Much care must also be exercised to differentiate spasm from incomplete filling due to insufficient opaque medium or air injection, from retained adherent fecal material and from true organic filling defects. This difficulty is seldom encountered since the three phases of the enema examinations afford checks on findings obtained during any one. Spasm is seen as a constantly changing, irregular outline of a contracted segment, with fine or coarse fibrillation of the haustra. If the

Fig. 6b. Spasm of entire ascending colon in double contrast enema. (Patient, female, aged thirty-two, early fibrocaseous pulmonary tuberculosis, tubercle bacilli in sputum, early ileocecal tuberculosis found at operation.)

roentgenograms were superimposed, the irregularity in contour could not be made to coincide, even though localized in the same segment. Spasm may not always be localized to the same segment in all the films, although it is usually confined to the right colon or the proximal half of the transverse colon in cecocolonic tuberculosis. Spasm in the distal segments of the colon may also be present, but is not regarded as significant during this stage of the disease (Fig. 6).

2. *Hyperperistalsis and Mass Hypermotility.* Peristalsis in the colon is accomplished by the disappearance of the haustra and contraction of the walls in progressive sequence of band-like segments. The irregular outline of the contained mass disappears, assuming a smooth elongated contour, like a blunt end sausage, and is then passed rather rapidly through the colon for a distance of 10 to 12 inches, or more, before coming to rest. Whether anastalsis or reverse peristalsis in the ascending colon is normal in man is yet to be confirmed. Though haustra undoubtedly change in size and shape as another mechanism of peristalsis without mass motility, this also is very difficult to follow roentgenoscopically and necessitates serial roentgenographic examinations with superimposed tracings, to record graphically. Mass peristalsis has been seen by many observers, but not frequently by any one. It probably occurs only at long intervals and as Hurst suggests, chiefly after eating or with urgency just prior to defecation. The rare roentgenoscopic observations of mass peristalsis in the right colon applies equally whether the colon is normal or pathological when studied with the in-

Fig. 7. The small residual column of barium contents seen in the mid transverse colon in this film made during the intermediary period of the enema examinations was first seen as retention in the cecum after evacuation. Slight palpation over the cecum was followed by mass peristalsis and this residual column was then seen to move continuously, except for repeated momentary hesitation, from the cecum to this position in the transverse colon before coming to rest.

Fig. 6c. Diagrammatic drawing of double contrast films to illustrate salient details of outline that are necessarily lost in reproduction. HF. Hepatic flexure. SF. Splenic flexure.

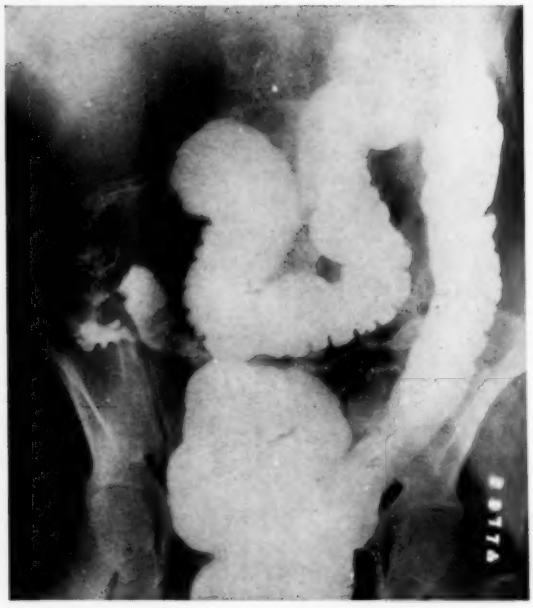


Fig. 8. Right colon almost completely evacuated by mass peristalsis. This patient was operated on and the appendix removed and found normal, but the cecum was also opened and inspected. A small tuberculous ulcer was found in the midst of several small scattered tuberculous nodules. She had incipient but open pulmonary tuberculosis. Resection of the ileocecal region was not done but patient has been placed on intravenous calcium and helio therapy.

gested barium meal. This is because in the presence of a pathological process the contents are resting in normal unirritated segments, already having been passed rapidly through those portions that are inflamed before the roentgenoscopic examination is made. But with the injected filling of the colon, *mucosal inflammation* with the concomitant *irritability of the nervous mechanism* seems certainly to be the cause for the frequency with which mass peristalsis is seen in the ascending colon, especially in the earliest stages of tuberculosis. One sees this mass hyperperistalsis not only during the injection of the opaque enema, but also during the intermediary examination and after the insufflation of air (see Fig. 7). If mass hyperperistalsis is missed during the opaque enema study, its presence may be indicated by the complete evacuation of the material from the diseased segment when the double contrast enema studies are made. When this is seen and is confined only to the same segment, then the site of the diseased processes can be reliably localized. In certain phases of the earliest stages of colonic tuberculosis, where the allergic reactions to the disease are minimum or absent and mucosal inflammation and irritability of the nerve plexuses are quite limited, mass hyperperistalsis in the affected segment may be elicited only after more or less vigorous palpation. Sometimes not even palpation will call forth this reaction until tried during the intermediary examination or after the air insufflation. Then palpation over a residual column of material, if it be in the diseased area of the colon, will suddenly result in mass peristalsis usually ending some distance beyond the diseased segment (Fig. 8).

3. *Anastalsis.* In the positive cases of this series, anastalsis was frequently observed; that is, refilling of the emptied segment by reverse flow of the opaque contents from the next distal segment, when the injection of the opaque material is discontinued. In the normal, after the injecta is propelled out of the diseased area, it more commonly never flows back again unless the injection of either the opaque material or air is continued or its pressure increased. Anastalsis is supposed to be normal in the healthy ascending colon, but has rarely been recorded in the normal, and so its frequent occurrence in the earliest stages of colonic tuberculosis (with observance of proper precautions in the injection technique) becomes duly significant.

It is true that the serial roentgenograms made from the seventh to the tenth hour after the ingested meal also reveal hypermotility through the affected segment of cecocolon in this stage. The "filling defects," however, which may be present in all the films of any one serial study are often difficult to interpret. They are not true filling defects which can be superim-

posed in all the films nor are they marked enough always to be sure that they are relatively emptied segments, and so doubtful interpretations naturally result in those cases where these variations occur, especially if, in addition, they are not exactly limited to the same segment in all the films. These doubtful cases thus examined were often confirmed only by revelation of hypermotility and hyperperistalsis with the enema examinations. But the enema studies, moreover, are also self-sufficient in that they afford roentgenoscopic visualization of these functional changes, the intermediary and double contrast examinations serving as checks on the single contrast enema findings. These examinations always furnish more definite and convincing evidence of these early functional changes in ileocecal tuberculosis than the barium meal serial roentgenographic method and are easier to employ, cause less strain on the sick patient and can be done with greater dispatch.

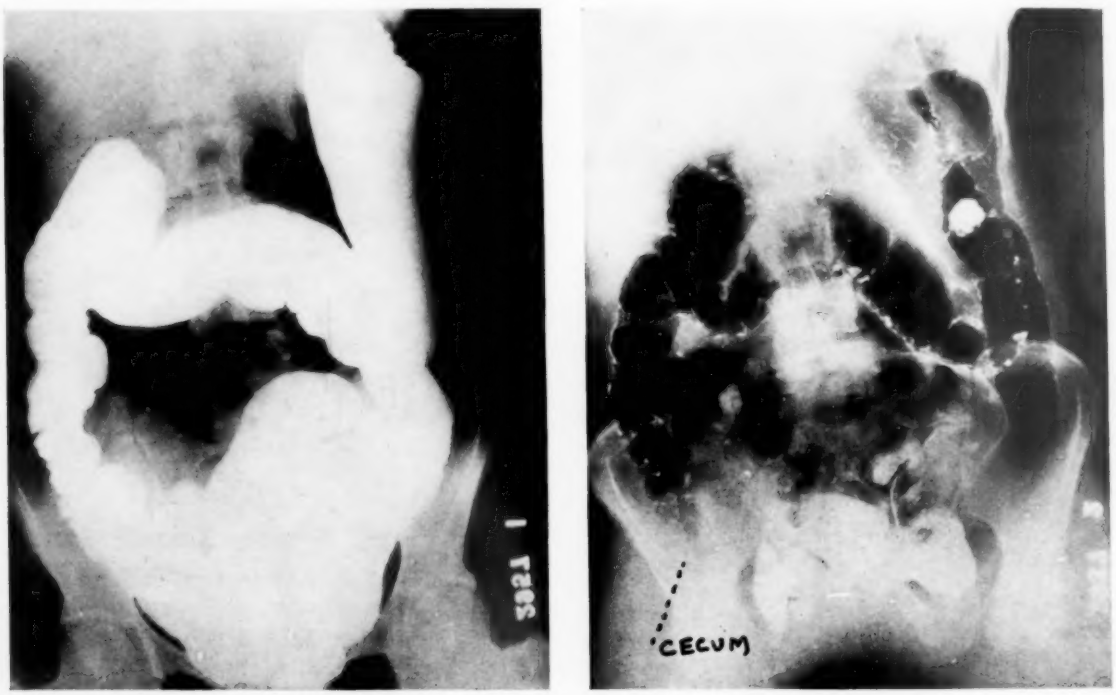
4. *Hypersecretion.* This phenomenon is a common finding, *seen only in the double contrast films.* This term may not explain the cause since it may not be actually hypersecretion from the irritated mucosal cells that is the underlying cause for this condition. It is more likely excessive inflammatory exudation and only partly hypersecretion of neurogenic origin that results in the uneven adherence of the barium suspension to the colonic mucosa as viewed in the double contrast films. After evacuation, the residual coating of barium which usually clings to the normal mucosa, seems to have been flushed or washed away by the excess diluent products of exudation and secretion in the diseased areas. While the normal mucosa thus seems to have retained a smooth uniform coating of barium in the double contrast films, the inflamed areas appear as if they had no coating at all; as if the opaque injecta had never even coated these segments. This appearance, however, may be associated only with the most acute forms of mucosal inflammation. In the more chronic varieties, the residual deposits of barium suspension assume different distributions. There may be irregularly defined localized areas of uncoated mucosa dispersed isolatedly in a segment, otherwise evenly coated; or there may be a more mucous, thready, criss-cross, checkered network of barium residue over the surface of the segment. If a catarrhal inflammation with excess mucus is present, which is a condition that it sometimes associated with ileocecal tuberculosis, having been possibly a contributing factor, one may then see a long sinuous thin or broad band of barium-impregnated mucus coursing through the column of air in the ascending colon whose walls are only faintly delimited, the opaque coating apparently having been washed away. The barium mucous residues may at other times be flaky and adhere to the

Fig. 9. Residual barium coating on mucosa of ascending colon appears almost completely washed away in most places while it is even, smoothly and uniformly adherent to the mucosa in the transverse and descending segments. Note absence of any defects of contour. (Female, aged twenty-nine, pulmonary tuberculosis, early fibrocaseous, grade 1, cecal tuberculosis, confirmed at operation.)

walls like plaques, irregularly outlined and distributed (Fig. 9).

5. *Pain and Tenderness.* Pain and tenderness were almost constantly found on palpation over the cecum or cecocolon in all the positive cases. Carnett's phenomena[6] occurring in cases of intercostal neuralgia were sought for in each case, using his recommended technique of examination. Only when this examination was negative and definite pain and tenderness were elicited by proper palpation over the affected segment, were we satisfied with the presence of these signs. Spasm, hyperperistalsis and hypermotility were often inaugurated with palpation, and cramp-like colicky pains ensued, of which the patient complains. We have repeatedly failed to elicit pain over the segment at the very beginning of palpation, but as soon as spasm and active motility started, the patient would complain of pain. The finding of pain over the cecum or cecocolon would occasionally be forthcoming when the head of the column of barium or air injecta would enter the affected segment, even before palpation was done. Many patients have pain or a sense of soreness or discomfort over the entire abdomen which comes on after the examinations and lasts for a few hours after these examinations. We were disturbed by this during the earlier studies because we feared some possible delayed complications, but after many normal cases were also studied in which this finding was present, the unimportance of its presence in early cases (as well as late in the disease) was then recognized. Sharp localization of pain to a small segment of the cecocolon is rarely found, the cecum or a larger segment, if not the entire length of the cecocolon, being more or less affected.

6. *Incompetency of the Ileocecal Valve.* This is found in almost every case of early tuberculosis, but since some claim that this may occur normally in a high percentage of



A B

Fig. 10A–B. Shortened contracted cecum. Note absence of barium coating of cecum in double contrast films.

cases, its value in this stage of the disease is possibly limited. But the filling of the terminal ileum, with partial or complete evacuation of the cecum or a portion of the cecocolon due to mass hyperperistalsis into the transverse colon, is an appearance that is seen in practically every positive case, whether in only one or more of the enema examinations. This appearance is the *analogue of the Stierlin phenomenon* (see Fig. 8) seen with the ingested meal, only that its formation is actually witnessed during the roentgenoscopic examination and its confirmation obtained in films made in a short interval of time with little inconvenience to patient or examiner.

Stage II. Moderately Advanced Cases

In the moderately advanced stage, not only may the phenomenon of the first stage be seen, but many additional signs become manifest. The anatomico-pathological changes are now such that they produce definite permanent roentgen defects and irregularities in the contours and outline of the terminal ileum, ileocecal valve and cecocolon, and are easily discernible. No longer must reliance be placed on functional changes alone of hypermotility, hyperperistalsis, irritability with spasm, pain and tenderness, in arriving at a diagnosis.

The disease is now well engrafted and the earlier lesions have progressed, the healing processes having lagged behind. Although fresh lesions may have cropped up elsewhere in a particular segment, it is

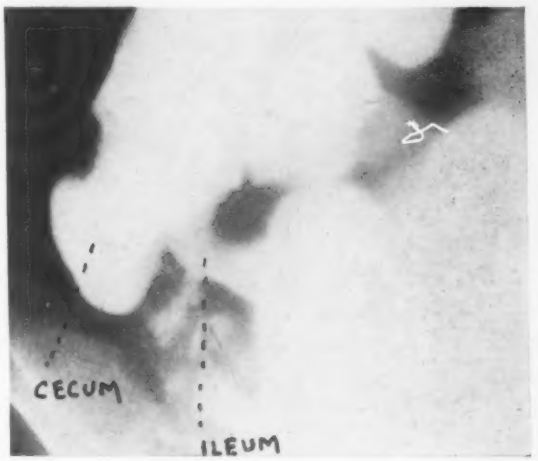
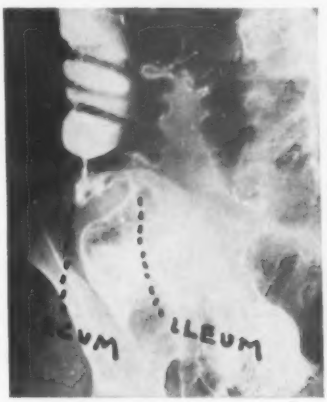


Fig. 10c. Tuberculous involvement causing fetal type contraction of cecum.

the older, more advanced processes that now produce the permanent changes that are roentgenologically discernible in the combined contrast films. Since the ileocecal region is the favorite site of these lesions, it is here that the first permanent changes are roentgenographically demonstrable. The deformities are most marked in the immediate ileocecal region, to either side of the ileocecal valve, in the terminal ileum and cecum and then less pronounced

D



E

Fig. 10d–e. Shortened, contracted, distorted cecum as shown by single and double contrast enemas.

FIG. 11. Permanent filling defects most marked in cecum, gradually becoming less in the ascending colon towards the hepatic flexure.

toward the more proximal portion of the ileum and the more distal portions of the cecocolon.

1. *Irregularities and Filling Defects*

a. In the cecum constant irregularities in its outline are seen, sometimes localized as when due to isolated deep hyperplastic ulcers, or more generalized as when due to more extensive superficial ulceration. Often the margins of the cecum has a crenated or fibrillated outline due to the spastic contraction associated with the ulceration. This appearance sometimes seems to be due to incomplete filling of the cecum, but this is ruled out by repetition of this appearance in the double contrast films. When the ulceration has called forth a more extensive fibrosis in the walls of the cecum, it may contract more uniformly and assume the fetal type. Occasionally, the lumen will be only irregularly contracted or shortened. Instead of appearing as the segment of the colon with the greatest intraluminal dimensions, as it really is, the caliber of its lumen is diminished to less than that of even the descending colon. These irregularities and defects in its outline and contour are permanent and are visible in the films of all the enema studies, the outlines in any particular case depending on the amount of fibrosis, ulceration, hyperplasia and spasm that may be present. Some of these changes are most strikingly seen in the double contrast films, since one can study not only the margins of the colon but also its intraluminal surface (see Fig. 10). In the early stages of tuberculosis, the right colon is invariably evacuated after defecation, with more or less complete flushing of the barium coating from the mucosa, but in this stage, irregularly outlined pools or lakes of residual contents are seen in the double contrast films either between the distorted, contracted areas of involved colon, or in the craters or under the excavated margins of the ulcers themselves. Adherent necrotic sloughs often give a bizarre trabeculated appearance to the coating of residual barium (Fig. 10).

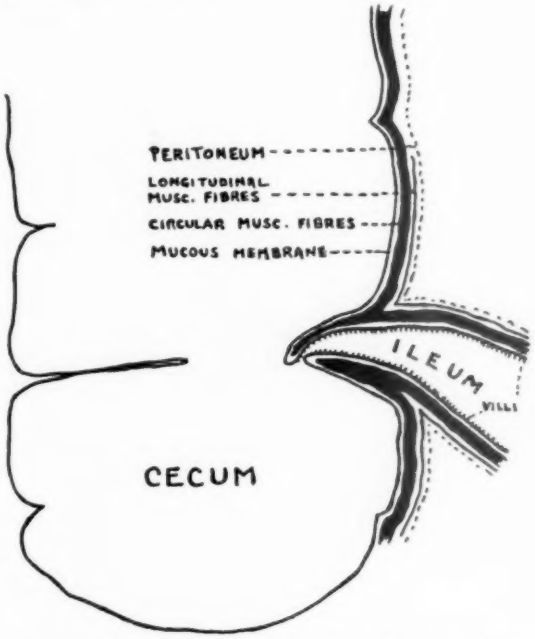


FIG. 12. Diagrammatic anatomical drawing of ileocecal valve.

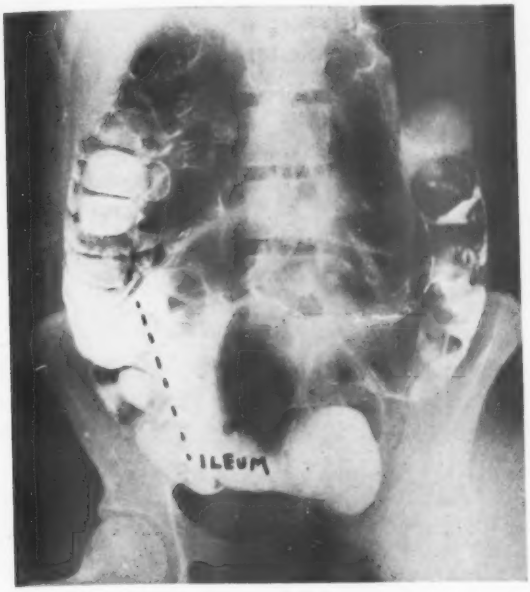


Fig. 13A. Profile view of ileocecal valve as seen in double contrast enema.

b. In the ileum, irregularities in its outline are seen similar to those in the cecum. Because of the incomplete filling, however, of the terminal ileum with both the opaque and air media, and the corrugation of its walls by the valvulae conniventes producing normally a serrated appearance to its margins, difficulty is met with in the interpretations of superimposed irregularities. Their constancy in both the single and double contrast roentgenograms, however, often helps in this differentiation.

c. In the ascending colon above the cecum, changes described as occurring in the cecum are also seen, but less marked, especially as the hepatic flexure is approached (Fig. 11).

2. *Fleischner's Sign.* This is a valuable sign in this stage of tuberculosis, and the anatomy of the ileocecal valve might well be reviewed here in order to understand this sign.

The end of the ileum telescopes or inserts itself through the colonic wall, carrying with it certain layers of that wall which project into the cecum in the form of two folds lying respectively above and below its orifice and constricting the two segments of the valve. The outer covering or serosa and the outer half of the muscularis or longitudinal muscular fibers of the bowel, take no part in this infolding, but are stretched tightly across the cressae produced on the exterior by inversion and thus serve to preserve the fold and the formation of the valve (Figs. 12 and 13).

As seen from the interior, the valve is made up of two crescentic segments, the labium superius and the labium inferius, the lower being larger and placed in an oblique plane, sloping upwards and inwards (i.e., towards the cavity of the cecum). Between these two segments is situated the slit-shaped opening which runs in an almost anteroposterior direction with a rounded anterior and a pointed posterior extremity. The two segments meet at each end of the orifice and are then prolonged around the wall of the cecal cavity as two prominent folds, the frenulum valvulae coli. It is thought that when the cecum is distended and its circumference thereby increased, these frenula are put on the stretch and pulling on the two segments of the valve, they bring them into apposition and thus effect the closure of the valve. This might explain why the ileocecal valve often remains competent in atonic or normal colons, even under increased pressure of the barium column and why there is quick reflux into the terminal ileum as soon as the slightest contraction or spasm of the cecum takes place. Not only does the oblique manner in which the ileum enters

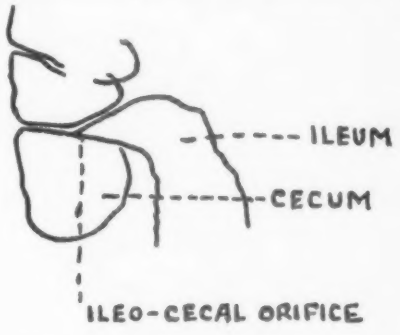


Fig. 13B. Diagrammatic drawing of Figure 13A.

or invaginates the colon (quite like the piercing of the bladder by the ureter) probably play a rôle in the matter of competency, but an additional factor is the

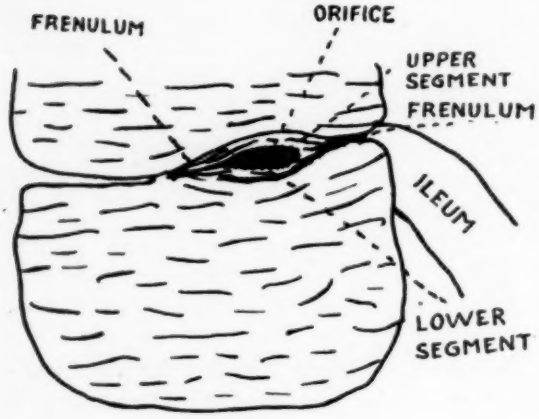


Fig. 14. Diagrammatic anatomical drawing of ileocecal valve as seen from inside of cecum.

usual position of the upper labium which usually projects further into the cecal cavity than the inferior lip, acting like a curtain and closing off the orifice. When the cecum contracts, this curtain is lifted by the rush of contents past it and with the orifice opened due to relaxation of the frenulum valvulae coli, the terminal ileum is filled. It is probably by this mechanism that we find almost without exception in every case of early ileocecal tuberculosis even where the orifice itself is not the seat of tuberculous ulceration, incompetency of the ileocecal valve. Although it is claimed by some investigators that the ileocecal valve is incompetent normally in as high as 80 per cent of all patients, in positive early cases we have practically always found it incompetent.

The roentgen appearance of the end of ileum in the sagittal plane is a cone or

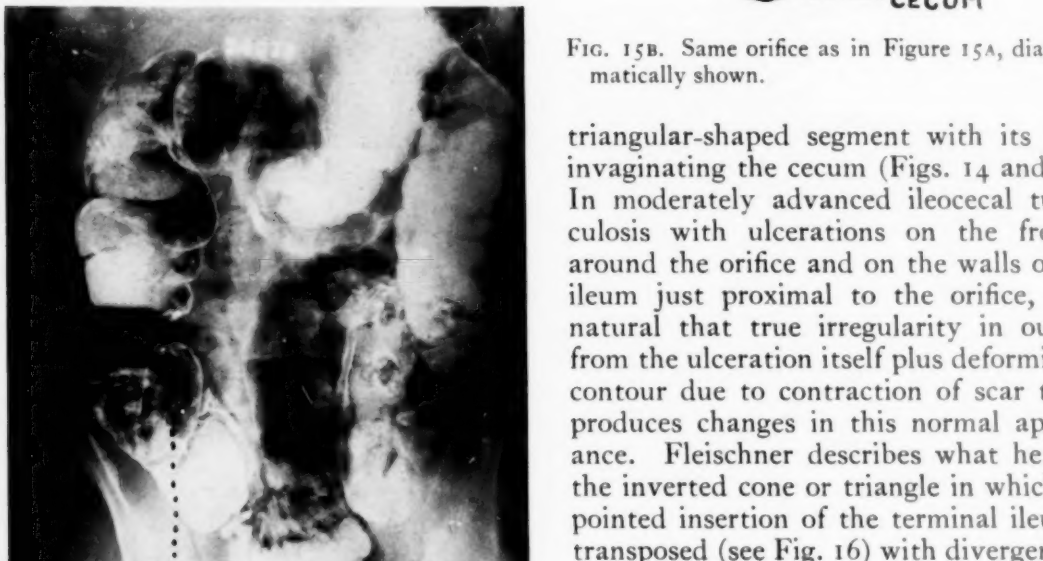


Fig. 15A. Orifice of ileocecal valve seen through air column in cecocolon.

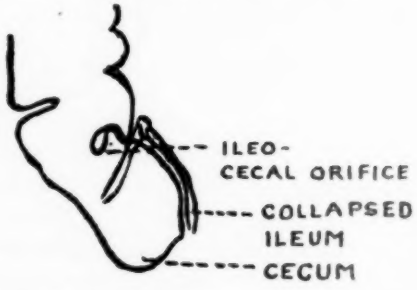
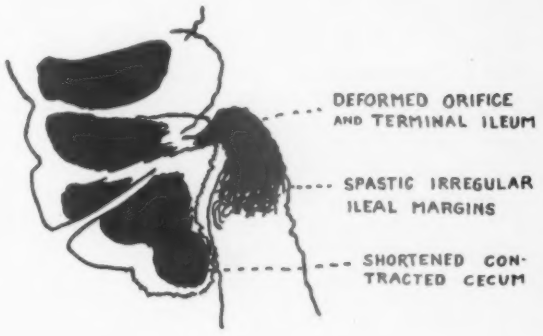


Fig. 15B. Same orifice as in Figure 15A, diagrammatically shown.

triangular-shaped segment with its apex invaginating the cecum (Figs. 14 and 15). In moderately advanced ileocecal tuberculosis with ulcerations on the frenula around the orifice and on the walls of the ileum just proximal to the orifice, it is natural that true irregularity in outline from the ulceration itself plus deformity of contour due to contraction of scar tissue produces changes in this normal appearance. Fleischner describes what he calls the inverted cone or triangle in which the pointed insertion of the terminal ileum is transposed (see Fig. 16) with divergence of the walls, like an inverted umbrella. But this is only one of the many deformities that are seen. Sometimes only the superior margin of the terminal ileum is irregular in outline, sometimes only the lower; oc-

A



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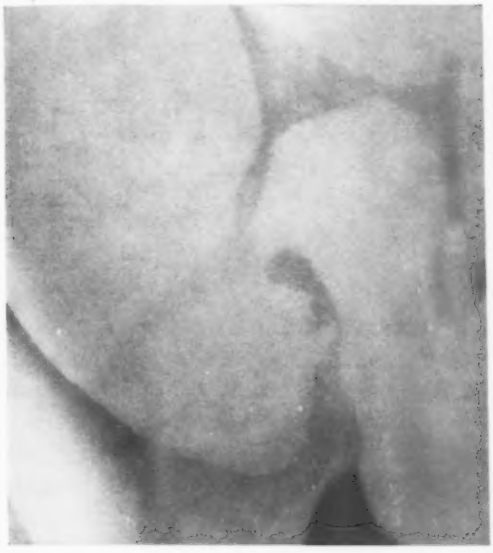

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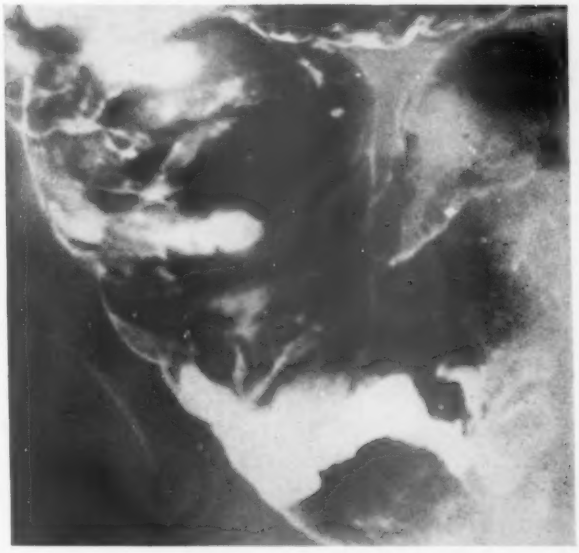

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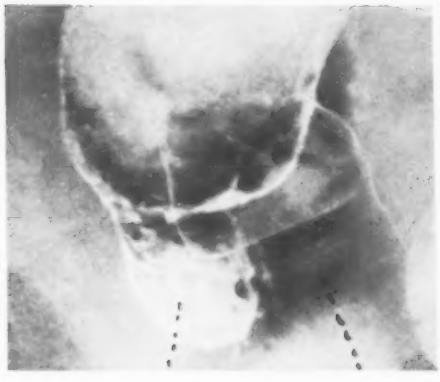
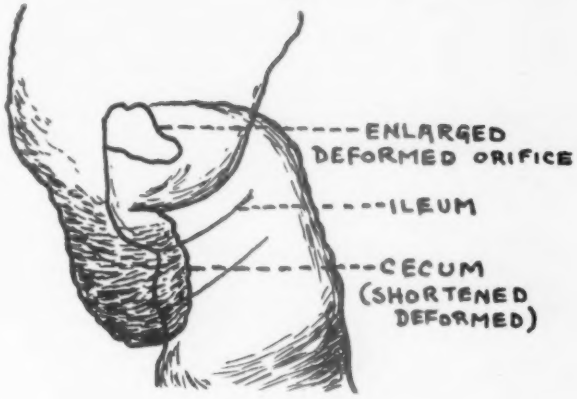


E



F

Fig. 16. Fleischner's signs. A. Double contrast film of ileocecal region. B. Diagrammatic drawing of A. C. Terminal ileum cylindrical instead of cone shape. D. Double contrast roentgenogram of C. E. Enlarged, ragged, deformed orifice seen through cecal air. F. Diagrammatic drawing of E.

casionally both walls are smooth and regular like an inflexible tube with no convergence of the ileal walls as it enters the cecum; in a number of cases we have seen the orifice of the valve end on through the air column in the cecum. In these cases, instead of an almond-shaped orifice, various distortions and irregularities of outlines are seen with usually an increase in the size of the orifice (Fig. 16).

Stage III. Advanced Stage

In the third or advanced stage any or all of the findings seen in the first two stages may be evident, but the changes of the second stage have become marked. The cecum may thus be almost obliterated due to fibrous contraction, or the lumen may be obliterated by excessive hyperplastic tissue (Fig. 17).

The difference between the ulcerative, indurative and hyperplastic types becomes more accentuated in this stage and not only do the enema studies reveal these differences better than the ingested meal studies, but the double contrast enema examination is best of all for the demonstration of these processes and their different variations. The hyperplasia about the ileocecal orifice may markedly distort and deform this region so that the true anatomicopathological deformities can no longer be visualized because the opaque injecta cannot get through. In these rarer instances, these deformities can be revealed only in the double contrast colographic examination. Air always enters the involved colon and carries with it enough of the barium suspension to reveal its deformed outline. One at first wonders why the barium injecta did not enter and reveal better than air, the sinuous irregularly contracted lumen instead of having been completely obstructed, coming to an abrupt end with a sharply limited margin (Fig. 18). Fischer explains this phenomenon as follows: The proximal normally distensible colonic walls fill up with the opaque mixture and distend proximally around the hyperplastic intraluminal tissue, causing complete compression occlusion of the lumen, thus making the barium column appear as if abruptly obstructed. When this happens, the double contrast method reveals the true process which otherwise would very closely simulate obstruction due to occluding malignancy. Without the double contrast method, it was formerly necessary in this event to fill the diseased segment by the ingested meal method and then carry out the enema study. The double contrast film in these cases obviates this extra preparation, revealing at once a very irregularly outlined narrow column of air with a stringy coating of barium. The slower the air is insufflated and the lower the air pressure, the more easily and thoroughly is the lumen of the affected segment outlined. In the moderate degrees of hyperplasia, the double contrast films often reveal flaky deposits of barium as if plaques of mucus

Fig. 17. Advanced hyperplastic tuberculosis of cecocolon, showing Fleischner's sign and irregular trabeculated appearance of mucosa as far as distal transverse colon.

or necrotic tissue impregnated with barium were present. Barium deposits, due to irregular accumulations of barium in the unaffected recesses of colon, or in craters in or between the irregular elevations of hyperplastic tissue give a mosaic or marble-like graining to the appearance of the barium-coated colonic mucosa. This uneven distribution of residual barium coating stands out in marked contrast to the uniform coating in the left side of the colon.

In all the films, the lumen of the ascending colon is markedly narrow, greatest usually in the cecum and less in progressive degrees towards the hepatic flexure. The injected air and barium thus seem as if they were entering a long narrow funnel, the narrow outlet being in the cecum and the walls being grossly permanently defective. These changes are revealed best in the double contrast enema roentgenograms.

In the indurative and superficial ulcerative cases, the cecocolon may be narrower than that of the descending colon, but with relatively smooth, fixed, parallel walls. Rarely, the proximal transverse colon will also be involved. In this variety, the right colon simulates the appearance of the usual form of left-sided ulcerative colitis with the so-called "lead pipe" deformity of the walls. Hyperperistalsis is not frequently seen in this type during the roentgenoscopic examination, and even after evacuation a short column of barium residue may be seen in the right colon during the intermediary and double contrast examinations. Possibly the rigidity of the walls with inability to complete contraction, is the cause for this retention. Again, the double contrast films reveal greater detail of all the pathological processes, often even making possible visualization of the larger ulcers and the muco-caseous exudate on the mucosa.

In many of the late phases of this stage, marked left-sided muco-spastic or atonic colitis may also be present, but obviously offers practically no confusion in diagnosis. The patient is usually in the terminal stages of pulmonary tuberculosis and the differential diagnosis is easy.

SUMMARY

1. Ileo-colography, using a double contrast air-barium enema is employed in the study of ileocecal tuberculosis, in conjunction with and after single contrast enema and an intermediary examination.

2. These examinations are more valuable than either the single contrast enema or the serial roentgenographic studies of Brown and Sampson alone because they not only furnish an equivalent of the spasms, hyperperistalsis and hypermobility, anastalsis, etc., with "filling defects," on which the diagnosis of early ileo-

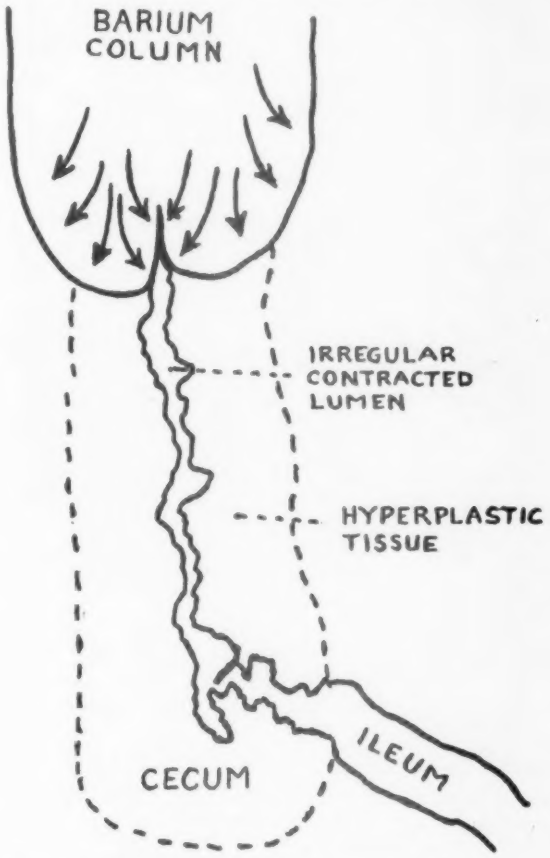
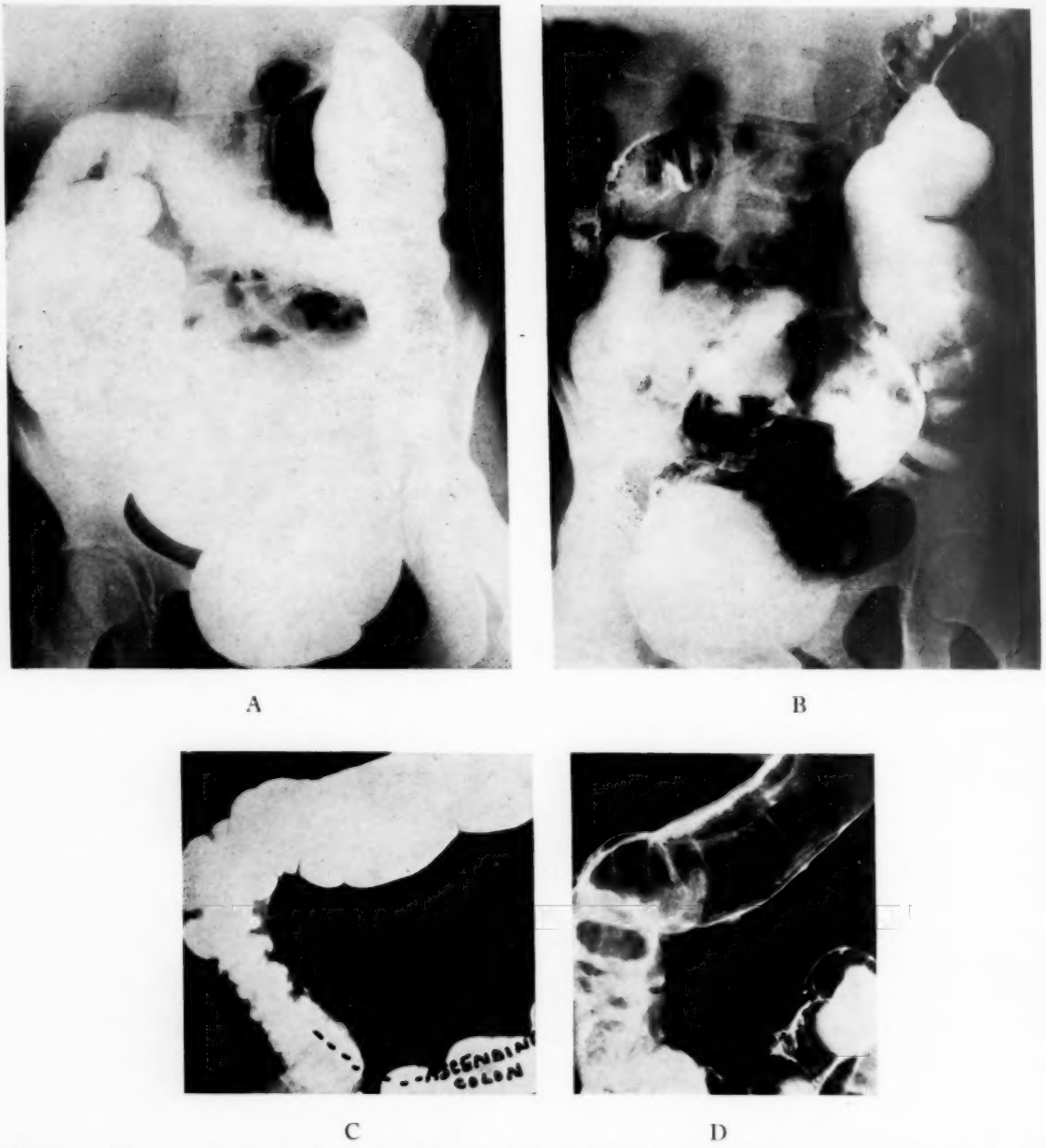


Fig. 18. Diagram showing advanced hyperplastic ceco-colonic tuberculosis causing complete obstruction to single contrast medium simulating malignant obstruction.



A B C D

FIG. 19. Advanced hyperplastic ileocecal tuberculosis. A. Single contrast enema. B. Double contrast enema. C. Deformed ascending colon, single contrast enema. D. Deformed ascending colon showing irregularity of outline and hyperplastic tissue protuding into the lumen at hepatic flexure.

cecal tuberculosis is based in the serial examinations, but they manifest these equivalents earlier and more definitely. Many new phenomena are seen only in the double contrast roentgenograms, making possible a better concept of the tuberculous processes, their extent and intensity.

3. The enema studies, as we have used them, are self-sufficient in making the diagnosis in all stages of ileocecal tuberculosis, allowing checks to be made on all the findings.

4. The double contrast roentgenograms reveal better than either the serial examina-

tions with the ingested meal or the single contrast enema roentgenograms, the anatomico-pathological changes of ileocecal tuberculosis, because both the intraluminal and parietal changes are more accurately and quickly rendered visible. This is especially true of the ileocecal valve, whose orifice can be seen in profile as well as end on through the air-filled cecum in the double contrast films.

5. The enema studies are made with greater dispatch and less annoyance to the patient and require fewer exposures than the serial examinations.

These enema examinations have been made a routine measure of study in every case admitted to Eagleville Sanatorium. We have found them not only of inestimable diagnostic value, but also when repeated at regular intervals, of precise prognostic value, furnishing a nice index of therapeutic progress.

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THE NORMAL POSITION OF THE PATELLA*

By S. B. BOON-ITT, M.D.
BANGKOK, SIAM

IN ONE of the weekly Literature Seminars of the Department of Orthopedic Surgery of the State University of Iowa, an abstract of a paper by Murk Jansen on the "Genu Impressum and Patella Alta Vera in their Relations to the Occurrences of the Fat Pad Impingement and the Dislocation of the Patella" was presented. A question was raised as to what is the normal relation of the patella to the femur.

In reviewing the literature on this subject since 1916, nothing was found to answer the question. Shands has reported a study of 100 roentgenograms of patellae of children between the ages of two and a half and six years in regard to the ossification center. Moloney considered the mechanics of the patella and by means of computation showed that the patella actually increased the moment of rotatory force acting upon the tibia. Carey dealt in detail with the dynamics of histogenesis in regard to patella, knee joint, and the muscles of the thigh. But so far as the normal relation of the patella to the femur is concerned, nothing was found. Cunningham's "Text Book of Anatomy" gives the patella relation as, "In the position of extension, the patella is retained at such a proximal level in relation to trochlear surface of the femur, that the distal articular facets of the patella are in contact with the trochlea." Gray's "Anatomy" states that, "As the leg is carried from the flexed to the extended position, first the highest pair, then the middle pair, and lastly the lowest pair of the horizontal facets are successively brought into contact with the patellar surface of the femur." Piersol's "Human Anatomy" states, "The patella in the upright position, when the muscles are relaxed, has the lower part of the articular surface resting against the top of that of the femur. When the muscle is contracted, the former is drawn entirely above the latter." Davis, in discussing the surface anatomy of the knee, says that, "About midway between patella and tubercle of the tibia on each side can be felt a groove which indicates the line of the joint and the location of the semilunar cartilages."

The study presented in this paper is based on lateral roentgenograms of 200 normal adult knees. These films were taken for clinical purposes relative to knee complaints, or in conjunction with the diseased knee for comparison. All films selected for this study were negative for any visible pathology of the joint. Generally, these roentgenograms were taken at a variable distance from the plates, ranging from 25 to 40 inches. This gave rise, therefore, to various sizes of knee shadows. Practically all lateral pictures of the knees were taken in the semiflexed position. It thus became necessary to resort to mathematical calculation to determine the position of the patella in full extension.

The method followed in this study is illustrated in Figures 1 and 2. The axes of both femur and tibia are first drawn through the centers of the shafts. These two axes *AB* and *OC* intersect and form an angle at *O*. The angle *COB* is measured and this gives the angle of extension of the knee. The line *HI* represents the plane of the articular surface of the patella. From the lower edge of the articular surface of the patella, *G*, line *GM'* is dropped perpendicular to the femoral axis *AB*. The length *LM'* will then be the distance of the lower edge of the articular surface of the patella from the lower edge of the external condyle of the femur, *L*, along

* From the Department of Orthopedic Surgery, State University of Iowa.

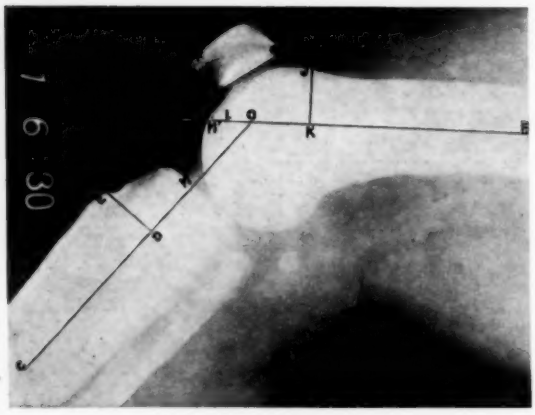

FIG. 1. Showing the method of approach and the measurements on a roentgenogram of a normal knee.

the axis of the femur. To get the thickness of the patella, line *FG* is drawn perpendicular to the line *HI*, and its length will represent the thickness. The line *JK* gives the distance of the patellar surface of the femur anterior to the axis *AB*. The distances of the anterior tubercle of the tibia from the tibial axis (*DE*), as well as from the upper external border of the tibia (*DM*), are measured. The line *EF* will correspond very closely to the ligamentum patellae, which is constant due to the inelastic nature of the ligament. Lastly, the joint spaces between femur and tibia, and between the femur and the patella are measured at the points where the two articular surfaces are more or less in contact. The width of the joint spaces will give the thickness of the articular cartilages and the interposed semilunar. All linear measurements are noted in millimeters and are estimated to 0.5 mm.

Figure 2 will illustrate the principle involved in the computation. The shaded tibia and patella show their theoretical positions in relation to the femur when the leg is fully extended. When the tibia is actively and fully extended as illustrated, the constructed irregular hexagon *EDOM'GF* is transformed into a trapezoid *E'D'K'F'*. It is assumed in this computation that in full extension as such, the axis of the femur will be in a straight line with the axis of the tibia in the sagittal plane. In actual normal condition it is recognized that the two axes do not subtend an arc of 180° but fall short of that value by a few degrees. It is further assumed that the articular surface of the patella is parallel to the axis of the femur: thus *FG*, *GJ* and *JK* will all be perpendicular to the femoral axis if extended. The patella, it is found, does not lie exactly parallel to the femoral axis either, but forms a small angle with the latter. With these assumptions, the computation is worked. By cutting out the lower rectangle whose sides are *E'D'* and *D'K'* (Fig. 3), the remaining section of the trapezoid will become a right triangle *E'F'P*. The hypotenuse *E'F'* is known, and the altitude *F'P* can be found by subtracting *E'D'* from *F'K'*, the latter being the sum of *FG*, *JK* and the articular cartilages of the patella and the femur, or *G'J'*. Knowing the two sides, the third unknown side can be computed by using the formula $a^2 + b^2 = c^2$. The base *E'P* of the triangle is equal to the line *D'K'*, and the latter is composed of three portions, *DM* or *D'M'*, articular cartilages with the

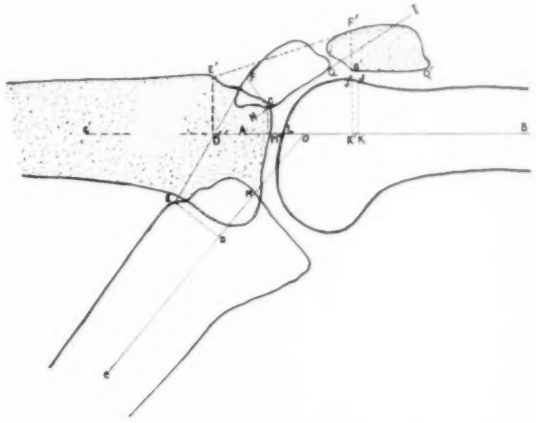

FIG. 2. Showing the principle involved in the computation of the index of patellar position. Index of patellar position in full extension = $LK'/G'\mathcal{Q}'$ Index of patellar position in semiflexion = $LM'/G\mathcal{Q}$ or in general the index may be expressed thus α/β, where α may be LK' or LM' and β may be $G\mathcal{Q}$ or $G'\mathcal{Q}'$.

semilunar ($M'L$), both of which are known, and the third portion, LK', the unknown. The computed value $D'K'$ less $D'M'$ and $M'L$ will give the length of the lower edge of the articular surface of the patella above the lower edge of the external condyle of the femur along the femoral axis, or the maximum height to which the patella may theoretically ascend.

There are several objections to the above computation. It is acknowledged that this method of approach by computation is far from accurate. However, it appears that this closely approximates the existing conditions. In a few cases, the roentgenograms were taken both in semiflexed position and in fully extended attitude. It is found by comparison, that the computed values of the position of the patella correspond fairly closely to the actual conditions measured directly upon the roentgenogram of the fully extended knee (Fig. 4). The actual measurements upon the roentgenograms mean very little, as the same object taken at different distances will obviously give different sizes of shadows. It would have simplified the calculation a good deal if the tube to patient to plate distances could have been kept constant. Yet, had a constant distance been used in this study, it would have meant little, for in general practice such constant distance pictures cannot always be obtained. One may seek to eliminate this difficulty by using a unit of length obtained from the picture itself, for it is known that various parts in the same picture increase or decrease proportionately in the shadow picture. Thus the height to which the patella may ascend in full extension is expressed in terms of a unit obtainable from the patella itself. This unit is the length of the shadow of the articular surface of the patella. The term "index of the patellar position," or in brief, "the patellar index," is introduced to denote the ratio of the distance of the lower edge of the articular surface of the patella (projected upon the femoral axis) from the lower edge of the external condyle of the femur to the length of the articular surface of the patella. Expressed in formula:

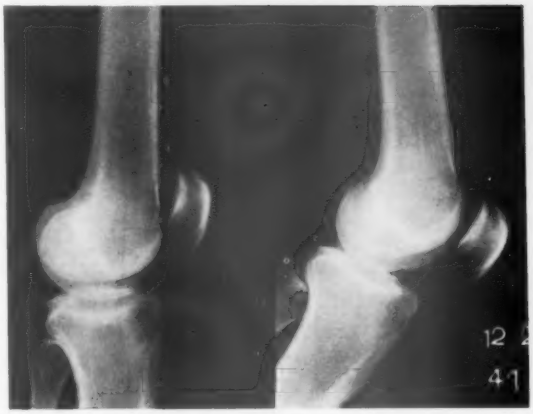

FIG. 4. Showing the same knee taken in semiflexed and in fully extended positions with the computation of the index.

$M'L$ = 11 mm. EF or $E'F'$ = 53 mm.
ED or $E'D'$ = 24 mm. FG or $F'G'$ = 21 mm.
$\mathcal{J}K$ or $\mathcal{J}'K'$ = 22 mm. $G'\mathcal{J}'$ = 4 mm.
DM or $D'M'$ = 12 mm. $G\mathcal{Q}$ or $G'\mathcal{Q}'$ = 36 mm.

thus $F'K' = F'G' + G'\mathcal{J}' + \mathcal{J}'K' = (21+4+22) =$ 47 mm.

$F'P = F'K' - E'D' = (47-24) = 23$ mm.

$a^2+b^2=c^2$ or $F'P^2 \times E'P^2 = E'F'^2$ or $(23^2+x^2=53^2)$

$x = 46.6$ mm. or $E'P = 46.6$ mm.

$E'P = D'M' + M'L + LK'$ or $46.6 = 12+11+x$,

then x or $LK' = 23.6$

Index $= LK'/G\mathcal{Q} = 23.6/36 = 0.66$

While LK in fully extended position as measured directly from roentgenogram = 26 mm. Its index = 0.72.

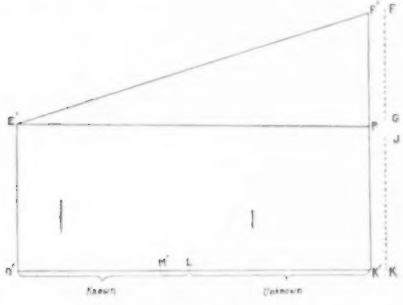

FIG. 3.

$F'K' = FG + G\mathcal{J} + \mathcal{J}K$; $F'P = F'K' - E'D'$

$D'K' = D'M' + M'L + LK' = E'P$

$(E'P)^2 + (F'P)^2 = (E'F')^2$

$LK' = E'P - (D'M' + M'L)$

Index in fully extended position $= \frac{LK'}{G'\mathcal{Q}'}$ while

Index in semiflexed position $= \frac{LM'}{G\mathcal{Q}}$.

Thus, in final readings of this study, the figures are given in terms of this index. The condition of the tone of the normal muscles of the thigh during the process of taking the roentgenogram may influence the height of the patellar shadow. But Gray's "Anatomy" states, "In the extended position, when the quadriceps femoris is relaxed, the patella lies loosely on the front of the lower end of the femur. During flexion the ligamentum patellae is put on a stretch." Practically all lateral views are taken in semiflexed position, and in such position the ligamentum patellae as well as the quadriceps muscle are put on a stretch, hence the contraction of the latter will move the leg rather than pull the patella up. It is only in full extension that the contraction or relaxation of the quadriceps plays an important part in the position of the patella, yet it can never pull the patella up higher than is permitted by the inelastic ligamentum patellae.

Following the above method, the index of the patellar position, both in the semiflexed and fully extended positions are computed. The computation for each case is done separately, realizing that the unit used in one film differs in length from the unit of the next case. The results are then grouped together according to the angles of extension of the knees. The average lengths of the articular surface of the patellae, and the actual measured distances of the position of the patella projected upon the femoral axis are tabulated.

From Table 1 it will be noted that the mean index of the patellar position in semiflexed knees shows a gradual decrease as the degree of extension changes from 180–140, thus, between 180° and 170° the index is 3/4, or 0.76, between 170° and 160° it is 2/5, or 0.44, from 160° to 150° it is 1/5, or 0.21, and from 150° to 140° it is 1/15, or 0.08; however, from 130° down to 90°, the index becomes increasingly negative since the patella has passed below the lower edge of the femoral condyle. The mean index of the patellar position in full extension, however, averaged for each group, is more or less constant, varying from 0.71 to 0.79. The mean index in full extension for the entire 200 cases is found to be 0.753. The result obtained from this study agrees with the gross descriptions given in various textbooks of anatomy. It is found that the patellar surface of the femur extends upon the lower end of the

Table 1

showing the patellar index in flexed position

Angles	Number of Cases	Average Length of Patella	Average Height Ascent of Patella	Index in Flexion	Index Computed for Full Extension
Between					
180–170	6	36.0	26.0	0.76	0.77
170–160	8	31.2	13.7	0.445	0.78
160–150	15	32.5	5.4	0.21	0.76
150–140	38	32.9	2.5	0.085	0.71
140–130	55	34.1	−2.5	−0.065	0.75
130–120	47	32.4	−3.8	−0.11	0.79
120–110	21	33.4	−8.0	−0.23	0.74
110–90	10	33.7	−8.1	−0.27	0.75
Total cases	200				

Mean index in extended position for all cases, 0.753.

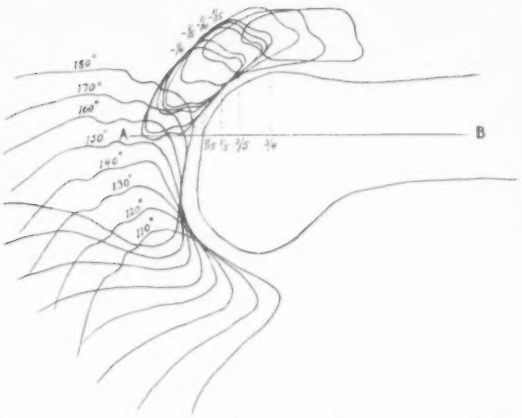

Fig. 5. Showing the relative positions of patella in various degrees of extension constructed from the findings in this study of roentgenograms of 200 knees.

femur about the length of the articular surface of the patella, measurement being taken along the femoral axis. Thus, an index of 0.75 means that the distal fourth of the patellar articular facet rests upon the proximal fourth of the trochlea of the femur. Figure 5, constructed from the results obtained in this study, shows the different positions of the patella in varied degrees of extension. These variations, plotted in graphic form, appear in Figure 6.

Jansen characterized patella alta vera as that condition in which the patella is too highly placed, with its lower pole being no longer at the level of the articulation. From this definition given by Jansen it follows that patella alta vera will have an index higher than one. In this study of 200 cases, it is found that 17, or 8.5 per cent, have an index of patellar position in fully extended attitude higher than one, 10 of which are but slightly above one (1.00–1.09), while the rest are between 1.10–1.36. The condition known as patella alta vera, or high patella, existed in a small percentage of these relatively normal knees.

CONCLUSIONS

1. The "index of patellar position" used in this paper refers to α/β, where α is

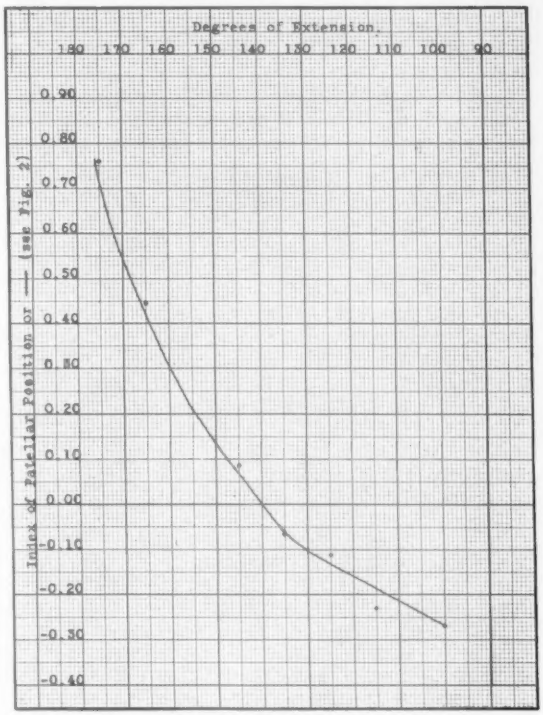

Fig. 6. Graphic representation of the relative position of the patella in various degrees of extension.

the difference in height between the lower edge of the articular surface of the patella and the articular surface of the femur, a quantity either positive or negative. This is measured by projecting this point of the patella upon the femoral axis or its prolongation, and measuring the distance along the axis from this point to the point where the articular surface of the femur intersects the femoral axis; and β is the length of the articular surface of the patella (see Fig. 2).

2. For determination as to whether the patellar shadow in a roentgenogram of the knee is too high or too low without complicated computation, a table was constructed to show the index of the patellar position in semiflexion as based upon the findings of the study of roentgenograms of 200 apparently normal knees. These indices were measured and computed for various degrees of extension:

Degree of Extension	Index
180–170	About 0.75 or 3/4
170–160	About 0.40 or 2/5
160–150	About 0.20 or 1/5
150–140	About 0.06 or 1/15
140–120	About −0.06 or −1/15
120–90	About −0.20 or −1/5

Thus, a patella may be said to be definitely high, if in a lateral view of a knee with about 140° of extension the lower edge of the articular surface of the patella is found to be about one-half of the patellar length above the lower edge of the articular surface of the femoral condyle, in other words, its patellar index in semiflexion is 1/2, where normally as found in this study it ought to be about 1/15.

3. The mean index of the patellar position computed in extended position for 200 knees was 0.753 or about 3/4.

4. Of this series 8.5 per cent had a patellar index higher than one, 3.5 per cent of which showed a markedly high patellar index.

5. Following the definition of patella alta vera as given by Jansen, its patellar index would then be higher than one.*

* I wish to express my appreciation and thanks to Dr. Arthur Steindler, the Head of the Orthopedic Department of the State University of Iowa, for his very helpful suggestions and for the opportunity to utilize his material. Acknowledgment is also made to Dr. Joseph E. Milgram for his very kind assistance.

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RESULTS OF ROENTGEN THERAPY IN GOITER, BASED UPON OBSERVATIONS IN FOUR HUNDRED CASES*

By GEORGE E. PFAHLER, M.D., *and* JACOB H. VASTINE, M.D.
PHILADELPHIA, PENNSYLVAINA

THE chronological development of the method of roentgen therapy in goiter has been ably reviewed by Holmes and Means, by one of us (G.E.P.), and by others. The etiology, symptomatology, and pathology have been discussed by such able authorities as Marine, Kimball, Else, Cole and Womack, Bircher, McCarrison, and others. For the sake of brevity these important phases of this subject have been omitted from this paper. It is sufficient to state that this method of treatment has been recommended by such able men as Borak, Curschmann, Mφller, Schwarz, Rowe, Christie, Holzknecht, Saberton, Soiland, Grier, Stevens, Hayes, Simpson, Groover, as well as by other authors.

With regard to the pathology, Read, Graham, Black, Hertzler, Stahnke, Hunter, and others, find no characteristic anatomical or histological alteration in the thyroid that constantly corresponds to the clinical picture. Satisfactory clinical classifications have been made, especially by Else, and a modification of this classification has been used by us as follows (Table 1):

TABLE I

OUR TREATED CASES HAVE BEEN GROUPED AS FOLLOWS

I Simple or Colloid	13
II Hyperplastic	
a. Non-toxic hyperplastic of adolescence	3
b. Toxic hyperplastic or exophthalmic	238
III Adenoma	
a. Non-toxic	26
b. Toxic	92
IV Thyroiditis	
a. Suppurative	0
b. Non-suppurative	2
V Malignancy	
a. Sarcoma	0
b. Carcinoma	26

Cases with hyperthyroidism treated with roentgen rays	327
Cases treated with radium	3
Non-toxic cases treated	44
Malignancies	26
Total cases treated	400
Total cases treated including malignancies	400
Simple or non-toxic goiters in which irradiation was not advised	132
Total	532

RESULTS OF ROENTGEN TREATMENT

I. *Simple, colloid, or non-toxic goiter* cases are treated by us only when they have failed to yield to medical treatment or refuse operation. We have, therefore, treated only 13 out of 145 cases which were referred for treatment. Good results with disappearance of the goiter have been obtained in at least 10 of these 13 cases. The other 3 cannot be traced. The average time since treatment of these has been 8.7 years. During this time, there have been no unfavorable symptoms and no hypothyroidism. The results were obtained after from one to three series of treatments in 7 of the cases. In 3 cases there were five, six, and seven series. Four of these patients have gone through pregnancy, subsequently, without recurrence. These results correspond quite closely to those obtained by Grier, Meyer and others.

II. *Hyperplastic Goiter* (*a. Non-Toxic of Adolescence*). We have treated only 3 of these cases, but in all the enlargement of the gland disappeared. One of these patients passed through pregnancy later without a recurrence.

b. Toxic Hyperplastic, or Exophthalmic Goiter. This group is identified by the age incidence—young adult life usually, though exophthalmos occurred in our cases from three to fifty-nine years of age, the average

* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept 17–20, 1929.

age being thirty-four years; 84 per cent of our patients were females. The gland is usually smooth and firm, sharply defined and slightly or only moderately enlarged. The toxicity usually undergoes spontaneous remissions and exacerbations if uncontrolled. The onset is rapid. Metabolic rate is high in a well-established case. The patient appears nervous and has an anxious expression. Tachycardia and frequent myocardial degeneration are present. The blood pressure is usually normal or subnormal with a high pulse pressure. Fever is present in crisis. Tremor of the extended fingers is present. The skin is moist. There is occasional quadriceps weakness. There is exophthalmos in varying degrees with the associated eye signs. Alopecia is sometimes seen. The symptoms are palpitation, subjective nervousness, increased appetite, weakness, fatigue, and loss of weight.

We have classed with this group, cases presenting the other signs and symptoms, but lacking exophthalmos. We have also included in this group, cases in which there were definite toxic symptoms, but no palpable thyroid enlargement.

The methods of treatment available are medical, radiological or surgical. In our opinion a combination of the two former methods is the procedure to be adopted in most cases of this type.

We have treated 235 cases which clinically could be classed as exophthalmic goiter. These have been rather arbitrarily divided into three divisions as to degree of thyrotoxicosis. The results which we believe are directly attributable to irradiation are listed as cures, i.e., those cases in which the basal metabolism, taken routinely since 1921, is between plus 10 per cent and minus 10 per cent; the pulse has returned to normal; the weight has increased, approximately, to what it was before onset of toxic symptoms; nervous and other clinical manifestations have subsided, and in which the goiter has either completely disappeared or is so involuted as to be entirely unobjectionable from a cosmetic standpoint. We have classed as improved those cases in which the basal metabolism is within normal limits or markedly decreased; in which all clinical signs of thyrotoxicosis have disappeared except a residual myocardial deficiency, which was present before institution of irradiation; or inoperable cases given radiation therapy to reduce the toxicity and prepare them for subsequent operative procedures. The response following irradiation is shown in Table II. Examination of this table shows 58.3 per cent of the cases definitely cured for an average of

Table II

EXOPHTHALMIC GOITER—235 CASES

	Cured	Markedly Improved	Not Improved	Unknown
Mild				
No. of cases	17	9	7	10
Percentage	51.5	27.3	21.2	
Average No. of treatments	4.5	3.8	4.7	2
Average time observed	7.1 yrs.	1.1 yrs.		
Moderate				
No. of cases	53	20	9	6
Percentage	64.5	24.4	11.1	
Average No. of treatments	6.6	4.8	3	1
Average time observed	6.0 yrs.	1.8 yrs.		
Severe				
No. of cases	56	32	13	3
Percentage	55.5	31.6	12.9	
Average No. of treatments	7	7.8	2	1
Average time observed	5.2 yrs.	3.4 yrs.		
Total				
No. of cases	126	61	29	19
Percentage	58.3	28.3	12.9	
Average No. of treatments				1.5

Total Cured or Markedly Improved 86.6 per cent

over six years. They were without evidence of toxic symptoms, visible thyroid enlargement, recognizable residual myocardial changes, and the exophthalmos was diminished. In addition 28.3 per cent were markedly improved. They were able to resume their occupation and their place in society, but their activities were restricted.

It can be seen by reference to Table III, that the percentage of cures is no greater in the mild than in the more severe cases.

TABLE III

EXOPHTHALMIC GOITER—DURATION OF SYMPTOMS BEFORE TREATMENT AND ITS RELATION TO THE RESULTS*

	Cured	Markedly Improved	Not Improved	Unknown
LESS THAN 3 MONTHS—29 CASES				
No. of cases	19	5	1	4
Percentage	76	20	4	
Average No. of treatments	6	5	5	1
3 TO 6 MONTHS—33 CASES				
No. of cases	24	3	5	1
Percentage	75	9.5	15.5	
Average No. of treatments	7.5	3	3	2
6 TO 12 MONTHS—33 CASES				
No. of cases	22	6	4	1
Percentage	69	18.5	12.5	
Average No. of treatments	6.5	8	1.2	1
MORE THAN 1 YEAR—115 CASES				
No. of cases	59	31	15	10
Percentage	56	29.5	14.5	
Average No. of treatments	7	6.4	2.7	1.3

* In 25 cases, the records did not include the duration of symptoms.

It may be concluded that the severity of the cases is no criterion by which the response to irradiation may be predicted. The duration, however, of toxic symptoms prior to institution of irradiation is a very important factor. Reference to Table IV shows that 96 per cent of the cases treated during the first three months of the disease were cured or markedly improved, and the average number of treatments necessary to effect a cure was less than in those of longer duration.

TABLE IV

EXOPHTHALMIC GOITER—PERMANENCY OF RESULTS IN CURED OR IMPROVED CASES

Time Since Treatment	Mild Cases	Moderate Cases	Severe Cases	Total
Less than 1 year	8	15	8	31
1–3 years	3	18	21	42
3–5 years	3	7	19	29
5–10 years	6	21	31	58
Over 10 years	6	13	8	27
Total	26	74	87	187

Of these 235 cases, 18, or 8.3 per cent, were subsequently operated upon. Of the 18 cases, 2, or 9 per cent, were post-irradiation recurrences, and of these 2, one recurred again after operation, but a second operation resulted in a cure. Both patients remained well. Ten of the 18 cases were unimproved after an average of four roentgen treatments, and we advised operation. With this combination, all have remained well. One patient had a rather stormy postoperative convalescence and was eventually relieved by medical measures. Four of the 18 cases were inoperable at the beginning, but were sufficiently improved by roentgen therapy and medical supervision to make operative procedures possible; one died as a result of operation; one developed postoperative tetany; the other 2 cases had an uneventful postoperative recovery. One of the 18 patients

had been relieved of the thyrotoxicosis by irradiation, but a large goiter was causing pressure symptoms and was removed surgically.

So far as we have been able to determine, 22 pregnancies in 17 patients were carried to a successful termination without recurrence of the previous goiter or toxic symptoms. The average time from the institution of roentgen therapy to delivery was three years and three months.

There were two *children*, both girls, treated in this series, one nine and the other three years of age. The former patient was given one series by another roentgenologist, three series of 50 per cent doses by us and then moved to a distant town. She was little improved and was operated upon six years after irradiation, with an ultimate uneventful recovery. The other child was first seen by us four years ago. She has received 16 treatments within two and a half years, of 50 to 60 per cent doses through a single portal. She has a slight remaining tachycardia and a marked exophthalmos. Visible or palpable evidence of the goiter has completely disappeared, her weight is about the average for her age and she is not nervous. She has been attending school and has been doing well. We regard her as markedly improved.

McGraw has published an excellent review of the literature upon exophthalmic goiter in children. He cautions against too radical surgical measures in these cases due to the likelihood of myxedema. Dinsmore has reported a series of 48 cases of exophthalmic goiter in children and states that they are extremely susceptible to all kinds of operative procedures and must be handled with extreme care. The surgical mortality is high in children and for this reason we believe that radiation therapy should be first employed and by this procedure relief of the thyrotoxicosis will usually be obtained and surgical measures with the attendant risk avoided.

Of the 235 cases of exophthalmic goiter, *19, or 8 per cent, were postoperative recurrences*. The average number of treatments given was a little over five. Of the 19 cases, 7, or 37 per cent, were cured; 8, or 42 per cent, were markedly improved; 4, or 21 per cent, were not improved. These last 4 cases received only one treatment each. Three of these postoperative cases died—2 as a result of goiter, one from influenza. The results from roentgen therapy in the recurrent postoperative cases we feel are quite encouraging, but they are not so good as in the cases not previously operated upon.

Sequelae. Of the occasional unfortunate sequelae, 10 patients, or 4.3 per cent, developed telangiectases in varying degrees. These patients were among the early cases and had an average of ten series of treatments, through four portals each, varying from 40 to 75 per cent skin erythema dose. This greatly exceeds the amount of radiation which we have recommended during recent years. Patients in whom there is an angioneurotic tendency are sometimes seen to develop an erythema directly after treatment. This is not a true radiodermatitis and does not lead to telangiectasis, but such patients should be given lower doses than the average individual.

Hypothyroidism. Four of these patients, or 1.7 per cent, subsequently had a metabolic rate which was less than normal. These patients received an average of eleven series each—more than we prefer to give at the present time. Of these, only 2 had clinical symptoms of hypothyroidism which necessitated administration of desiccated thyroid. One of these 2 has recovered, and the other is improving.

Hoarseness was not present in any patient in whom it was not present previous to irradiation. Tetany did not occur as a post-irradiation complication.

Of the 235 cases of exophthalmic goiter, 19 have died from various causes (Table v). Eight patients died of con-

TABLE V

OF THE 235 CASES OF EXOPHTHALMIC GOITER, 19 HAVE DIED FROM CAUSES SHOWN BELOW

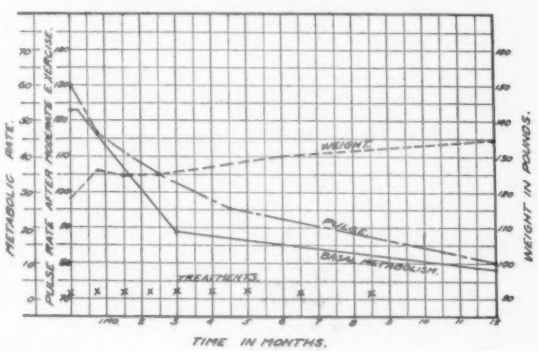
Severity	No. of Treatments	Time after Last Treatment	Improvement from Irradiation	Cause of Death
Severe	13	4 years	Cured	Pneumonia
Moderately severe	13	10 years	Cured	Pneumonia
Postoperative recurrence	1	1 year	Improved	Influenza
Moderately severe	14	8 years	Improved	Carcinoma of throat
Moderate	1	2 months	Improved	Gangrene of leg
Severe	6	5 years	Improved	Gangrenous laryngitis
Moderate	7	5 years	Cured	Unknown, not hyperthyroidism
Moderate	3	1 year	Improved	Hypertension present many years
Severe	7	2 years	Improved	Myocarditis
Moderate	7	5 years	Cured	Tuberculous meningitis
Severe	6	3 years	Improved	Nephritis—present before irradiation
Severe	2	2 years	Improved	Nephritis
Severe	3	1 year	Improved	Thyroidectomy
Severe	3	2 months	Unimproved	Hyperthyroidism
Severe	2	2 months	Unimproved	Hyperthyroidism
Severe	1	2 years	Unimproved	Hyperthyroidism
Critical	1	5 days	Unimproved	Hyperthyroidism
Critical	1	8 days	Unimproved	Hyperthyroidism
Moderately severe	1	1 month	Unimproved	Hyperthyroidism

ditions entirely unrelated to the thyroid. One died of hypertension present many years—antedating the goiter. Two died of nephritis and one of myocarditis. These may have resulted from the thyrotoxicosis. When treated they were very severe, probably inoperable, cases. One patient received three treatments with improvement. A thyroidectomy was performed a year later which resulted fatally. This patient was sufficiently improved by roentgen therapy for the surgeon to regard her as an operable case. Six of these 19 were very advanced cases, in a critical state of toxicosis, failed to respond to irradiation and died before we could give more than one series of from one to three treatments. In 2 of these cases it was necessary to employ radium in the home. It is interesting to note that *2 of these last 6 cases were postoperative recurrences and degenerative changes were advanced due to prolonged toxicosis.*

The composite Chart 1 shows the response to irradiation and especially the

CHART NO. 1.

COMPOSITE CHART - EXOPHTHALMIC GOITER.



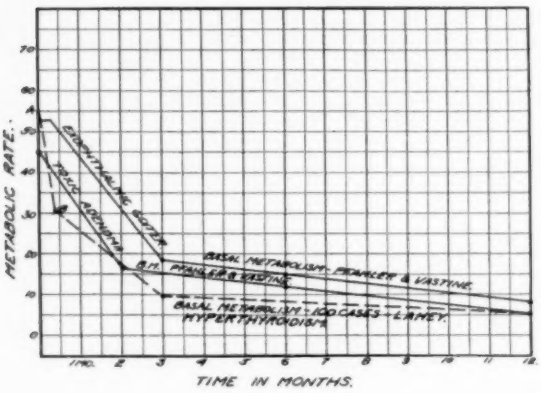
relations of the gain in weight to the decrease in pulse rate, and the decrease in the metabolic rate.

The composite Chart 2 gives a comparison of the drop in the basal metabolic rate during roentgen therapy, as shown by our records, compared with the record

of 100 cases treated surgically by Lahey. The metabolic rate decreases more slowly following roentgen therapy, but it must be borne in mind that the marked drop between A and B in the curve of surgical

CHART NO. 2.

COMPARISON - SURGICAL & RADIOLOGICAL RESPONSE.



cases is effected by rest in bed with medical supervision before any surgical measures have been employed. The patients treated roentgenologically are ambulatory and often pursuing their usual activities.

III. *Adenoma.* *a. Non-toxic.* This is characterized by a rather large, firm, nodular, usually circumscribed thyroid enlargement, bosselated to palpation. These occur in the later decades of life, the average age of the 26 cases treated by us being 44 years. These adenomas usually become progressively larger over a period of years, the average duration in this small series of cases being 6.6 years from time of first noticing the goiter until coming under our care. Medical treatment is ineffectual in relieving this condition, or retarding its progress. Iodine is definitely contraindicated because it not infrequently converts an innocuous adenoma into a severe toxic case. Rather small localized adenomata, in which localized doses of roentgen rays may be employed, are those in which irradiation offers the most hope of improvement. The duration of the goiter from a statistical analysis of our cases is unrelated to the response which may be expected from irradiation. In spite of this, we treat the adenomas of shorter duration more optimistically than those of longer duration. *Large adenomas are better treated surgically than radiologically.* Numerous cases were seen by us and not treated.

There were 26 patients with small nontoxic adenomas referred to us. These were practically all given localized doses to the adenoma through single portals. In over 56 per cent of these, there was a complete disappearance of the adenoma to palpation for an average of seven years without recurrence. In 26 per cent of these 26 patients, there was a marked decrease in size so that the goiter was scarcely visible. The average duration of these cases is also seven years without recurrence. A disappearance of the goiter was effected with an average of four localized doses of 50 to 75 per cent. Four cases after an average of 3.2 treatments showed no improvement and were subsequently operated upon. One patient died from pulmonary tuberculosis two years after treatment for goiter. There were no post-irradiation skin changes observed. None of the patients have shown any evidence of hypothyroidism.

b. Toxic Adenoma. These present the same characteristics upon physical examination as the adenomata in which symptoms of a thyrotoxicosis have developed. These are usually seen in the later decades of life, the average age in our series being 46.7 years. They are usually of long duration, the average being 9.3 years. It is generally thought that all adenomas, eventually, unless arrested in their progress by surgical or radiological measures, manifest evidence of hypersecretion. Unlike the exophthalmic goiters, however, these symptoms usually develop insidiously and the duration of toxicity is often rather vague. This occurred more frequently in females, 82.5 per cent of our series. The cardiac changes are often more pronounced in a well-estab-

lished case than in exophthalmic goiter, due to the longer duration of toxicosis and the more advanced age of the patient. There is less loss of weight and the nervous symptoms are less pronounced than in exophthalmic goiter. Exhaustion is usually greater. The metabolic rate is usually lower than in exophthalmic goiter.

In our series of 92 cases of toxic adenoma, the response to irradiation with special relation to the duration of the toxic symptoms could not be definitely determined due to the insidious development of the toxic symptoms and inability to definitely know the duration.

The response to roentgen therapy with relation to the severity of the toxic symptoms is shown in Table VI. It can be seen that the percentage of definite cures is slightly less than in exophthalmic goiter, but the percentage of cases markedly improved is definitely greater. In our series of 92 toxic adenomata, *91.8 per cent were either cured or markedly improved.* This compares very favorably with the other methods of treatment, particularly when it is noted that the cases have averaged approximately six years under observation since roentgen treatment. Only one case has shown a subsequent adenoma. This developed on the opposite side to that treated and was first seen six years after disappearance of the previous adenoma. It was not a recurrence but a new growth. The severity of the cases did not appreciably affect the response to irradiation, the severe cases responding as well or better than the milder cases. Duration of the goiter played no rôle. Duration of toxic symptoms apparently had little effect upon response, though this is usually rather indefinite.

Table VI

Results of Roentgen Therapy in 92 Cases of Toxic Adenoma

	Cured	Markedly Improved	Not Improved	Unknown
Mild				
No. of cases	15	11	4	4
Percentage	50	36.7	13.2	
Average No. of treatments	3	4.5	4.7	1.5
Average time observed	3.8 yrs.	1.4 yrs.		
Moderate				
No. of cases	25	11	3	2
Percentage	64.0	28.2	7.8	
Average No. of treatments	7	5.2	4.8	
Average time observed	6.0 yrs.	1.1 yrs.		
Severe				
No. of cases	7	9	0	1
Percentage	43.8	56.2	0	
Average No. of treatments	7.2	6.3	0	1
Average time observed	6.7 yrs.	2.1 yrs.		
Total				
No. of cases	47	31	7	7
Percentage	55.3	36.5	8.2	
Average No. of treatments				
Average time observed				

Total Cured or Markedly Improved 91.8 per cent

Table VII

Toxic Adenoma—Permanency of Results

	Mild	Moderate	Severe	Total
Less than 1 year	7	5	4	16
1–3 years	8	10	1	19
3–5 years	2	3	7	12
5–10 years	4	10	3	17
Over 10 years	5	7	2	14
Total	26	35	17	78

The enlargement in exophthalmic goiter usually disappears completely following irradiation, but next to the exophthalmos is the last symptom to disappear. There is usually a marked decrease in size of the adenomatous type of goiter, but frequently not a complete disappearance. Frequently a small palpable nodule remains which is of no significance unless causing pressure symptoms and then it can easily be removed surgically with little inconvenience to the patient.

In 7 cases, or 8.2 per cent, of this series, there were subsequent operations for goiter. The average number of treatments given previous to operation was 6.7. Two cases failed to show a response to roentgen therapy. In 5 cases there was a marked relief of toxic symptoms, but operation was performed for persistent thyroid hypertrophy which was causing pressure symptoms. Of the 7 patients operated upon, 6 are now well or markedly improved. One patient was improved by radiotherapy, but died during a thyroidectomy a year later.

Three cases, or 3.3 per cent, of this series were postoperative recurrences. Of these, one was definitely cured; one markedly improved, and one failed to respond to irradiation.

Twelve of this group of cases of toxic adenoma have died, which is not surprising when the advanced age of some is considered as shown in Table VIII.

There are only 3 of the 12 deaths in the 92 cases of toxic adenoma in which the fatal termination could be attributed to the goiter. One patient was improved by roentgen therapy but died during a thyroidectomy, a year later. One patient received 2 roentgen treatments without improvement and died six months later as a result of the thyrotoxicosis. One patient was markedly improved following four roentgen treatments, but following administration of iodine became rapidly worse and died. At this time we would again like to caution against the administration of iodine to patients with adenomata.

Sequelae in Toxic Adenoma. In 4 of the 92 cases of toxic adenoma, there were skin changes with telangiectasis, after seven, eleven, thirteen, and twenty-three series of treatments, the latter twenty-three treatments being single portals over the adenoma. This is greater dosage and

TABLE VIII

CAUSES OF THE 12 DEATHS IN THE CASES OF TOXIC ADENOMA

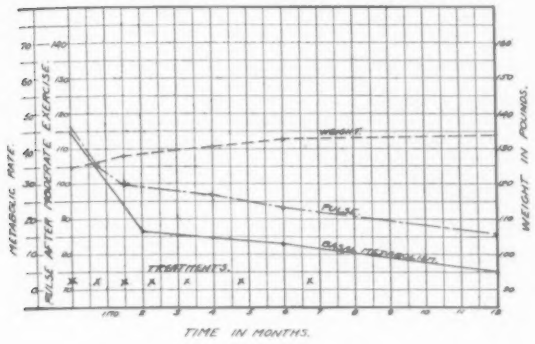
Severity	No. of Treatments	Time after Last Treatment	Improvement from Irradiation	Age at Death	Cause of Death
Mild	3	11 years	Cured	58	Carcinoma of uterus
Mild	6	8 years	Cured	47	Tuberculous pyelitis
Mild	2	2 months	Improved	48	Lung abscess following extraction of tooth
Severe	9	4 years	Improved	47	Cause not known
Severe	7	4 years	Cured	64	Cause not known; not goiter
Moderate	8	10 years	Cured	75	Cause not known; not goiter
Moderate	4	2 years	Improved	55	Hysterectomy
Moderate	6	20 years	Cured	75	Heart disease
Severe	9	6 years	Improved	68	Nephritis
Moderate	8	1 year	Improved	45	Thyroidectomy
Moderate	2	6 months	Not improved	65	Toxic goiter
Severe	4	4 months	Improved	60	Toxic goiter—following iodine administration

more prolonged irradiation than employed at the present time. One of these patients was later operated upon.

None of the cases developed symptoms of hypothyroidism following irradiation, and in none was there manifested any evidence of other unpleasant sequelae except those already cited.

CHART NO. 3.

COMPOSITE CHART - TOXIC ADENOMA.



Composite Chart 3 shows the representation of the weight, pulse, and metabolic rate for cases of toxic adenoma and their response to irradiation.

IV. *Thyroiditis. a. Suppurative.* Roentgen therapy plays a small rôle in the treatment of this rather rare condition. It is conceivable that a single mild dose might be efficacious in the relief of pain as in some other infections, but we have had no experience in treating suppurative thyroiditis.

b. Non-suppurative Thyroiditis. This condition is less rare. Pemberton, in a series of 500 cases of exophthalmic goiter has reported 54, or 11 per cent, presenting varying degrees of thyroiditis at the time of operation. He states that it is patients of this type who later report with myxedema.

In our series of cases there were probably many with thyroiditis which could not be recognized clinically. There were 2 in whom the clinical evidence strongly favored thyroiditis, i.e., rapid enlargement of the thyroid, with marked tenderness of the gland, associated fever and tachycardia. Nervous symptoms were not pronounced. One patient was apparently completely relieved of all thyroid enlargement and the associated symptoms, two weeks after a single dose of roentgen rays over the thyroid. In the other patient, relief was obtained more slowly, five series of treatments through two portals each, over a period of five months being necessary to obtain a complete relief from symptoms and a disappearance of the thyroid enlargement. No evidence of hypothyroidism developed in either of these cases, though two years has elapsed since the treatment of the former patient and nine years since the treatment of the latter.

Christie has reported a very satisfactory result from roentgen therapy in a case of thyroiditis. Groover has also reported on this condition.

V. *Malignancies of the Thyroid.* We have treated 26 malignancies of the thyroid gland. One of us (G.E.P.) reported upon 10 of these in 1922. Time does not permit a discussion of these at the present time.

Substernal Goiter. This condition presents a rather difficult problem to the medical profession. Surgical removal is difficult and attended by a rather high mortality. The possibility of mediastinitis is always great following surgical interference and not infrequently hematomas develop which sometimes cause a fatal embarrassment of the respiration. Shock is always great in these cases and this is particularly distressing in toxic cases. The most annoying symptoms usually resulting from substernal goiters are those due to pressure. Grier has analyzed 26 cases which he had irradiated, and concludes that irradiation is of value in treating exophthalmic goiter and adenoma, but is of little value in the colloid types of goiter. He prefers high voltage roentgen therapy in 80 per cent skin erythema doses through anterior and posterior portals.

We have treated 12 cases of substernal goiters, 6 of which had exophthalmos and could be regarded as that type of goiter.

A disappearance of the goiter was effected in 5 of these cases. One patient received only one treatment and was unimproved. Three of these 12 substernal goiters occurred in older individuals without exophthalmos and were probably adenomata. Two of the 3 were unimproved by low voltage roentgen therapy over the anterior mediastinum. One was improved by a total of 200 per cent of an erythema dose of roentgen rays generated by a high voltage machine, given in fractional doses over a period of two months. Two cases with non-toxic substernal goiter were not improved by low voltage irradiation, one having received two treatments and the other only one. The results in one case after a single treatment is unknown.

Thymic Enlargement in Goiter. There were 23 cases in which thymic enlargement could be definitely recognized roentgenographically. Twenty-one of these were cured and 2 greatly improved by irradiation of the anterior mediastinum and thyroid region. Thymic enlargement was probably present in a far greater number of cases in which it could not be demonstrated. Hunter states that the thymus is frequently found to be present and hypertrophied in autopsies on cases dead of hyperthyroidism.

The simultaneous presence of *uterine fibroid and goiter* has already been reported and cases have been cited by Brown in 1924, Khoór in 1926, and Lindenberg in 1928. In our cases there were 8 in which the presence of uterine fibroid was recognized. Routine pelvic examinations have not been made in cases of goiter and the patients have not been minutely questioned concerning genitourinary symptoms, and thus many small, silent fibroids have probably been overlooked. In the 8 patients, fibroids occurred in 3 with exophthalmic goiter, 4 with toxic adenoma and one with non-toxic adenoma. In 2 of the 8 patients, myomectomy was performed. In the rest the fibroids were treated by irradiation, with a disappearance of the fibroid or marked decrease in size in all of them.

There was a disappearance of the goiter or marked diminution in size in 7 of these 8 cases following irradiation of the goiter. One patient was unimproved after 2 treatments.

TECHNIQUE

The technique employed in the treatment of goiter has been fragmentarily discussed in connection with the treatment of different types of goiter. We will briefly review this. The anterior cervical region is divided into four areas—two anterior and two lateral—each approximately 5×15 cm. in size, with the anterior areas extending well down over the upper mediastinum. The upper limit is taken well below the cricoid cartilage, 2–3 cm., and the larynx protected with lead. The rays are directed medially and downward so that a cross-firing effect is produced.

The factors employed by most roentgenologists in the usual treatment of goiter are quite similar and the technique has become fairly well standardized. We employ a 9 inch spark gap, 5 ma., at a skin target distance of 10 inches, with 6 mm. Al filtration. In simple or colloid goiter we give one or two series of 30 to 40 per cent skin erythema dose over two to four areas. This is attended by practically no danger of hypothyroidism. In adenoma, localized doses are usually employed, sometimes cross-firing the adenoma through two portals. In the milder toxic cases we give an initial 50 per cent skin erythema dose through each of the four portals; this is repeated in three weeks with less radiation, 40 to 50 per cent usually being employed. The interval may be prolonged to from four to eight weeks and the amount of irradiation gradually reduced. Later factors are largely determined by the response to irradiation. It is probably wiser to give 30 to 40 per cent initial skin erythema doses in the severer cases, gradually increasing to 50 per cent S.E.D.

The number of such series must be determined by the individual response of

each patient. We are usually rather loath to give more than eight or ten series, and expect almost complete relief after six series. Many patients have been seen in which scarcely any benefit could be noted until after six or eight series, and then the response has been very rapid. We believe, however, if a patient is not definitely improved after three or four series and a lapse of two to three months after instituting radiation therapy that other measures should be employed. The patient's weight, pulse after rest and mild exercise, the general condition and the condition of the skin are recorded at each visit. Frequent metabolic determinations are advisable, particularly in patients in whom there was a very great elevation previous to beginning treatment. In these cases when the metabolic rate has reached plus 20 per cent, we usually prefer postponing treatment, and not infrequently in one or two months it has reached a normal level as a result of the previous treatments.

Routine dental examinations are made to determine the presence of focal infection. It is not an uncommon experience to note a marked improvement following the removal of foci of infection. The tonsils are examined and removal advised if they are at all questionable. The sinuses are examined if there are any suggestive symptoms referable to them. This examination, however, is not made routinely. A routine chest examination is made to record the size of the heart, determine the presence of thymic enlargement or substernal goiter. Pulmonary tuberculosis presents many symptoms simulating hyperthyroidism and it is well to exclude this condition by the chest examination. Oblique films of the upper mediastinum as described by one of us (G.E.P.) in 1921 are valuable in outlining the lower limits of the thyroid enlargement.

ASSOCIATED MEDICAL TREATMENT

This, we believe, is a very important consideration in the management of cases of goiter. Reference to Chart 2 shows the marked relief obtained in Lahey's cases in ten days of hospitalization under medical care prior to operative measures. The decrease in the metabolic rate in this time is from 56 to 31 per cent, or an average drop of 25 per cent. This is usually obtained by the administration of iodine, sedatives and rest. It is our opinion that iodine in conjunction with roentgen therapy is not generally wise. Several patients with exophthalmic goiter have been observed whose improvement was definitely accelerated by administration of iodine, but several were apparently made worse by this drug, and upon discontinuing it improvement went on uninterruptedly. In very severe cases under hospital regime, Lugol's solution for several weeks is often efficacious when combined with roentgen therapy but we do not feel that it should be employed routinely. We have observed patients with toxic adenoma become worse after administration of iodine. One patient who was improving under roentgen therapy was given iodine, with marked increase in toxicity and a rapidly fatal termination. Iodine should, in our opinion, not be given to patients with toxic adenoma and only in selected cases of exophthalmic goiter.

The general medical care of the patients is usually left to the discretion of the family physician. We sometimes recommend the use of quinine hydrobromide in 5 gr. doses t.i.d. until ringing in the ears occurs. Digitalis is sometimes suggested, though this drug is less effective in the tachycardia and decompensations of hyperthyroid origin than in other cases. A list of general instructions is given to the patient recommending rest, a high caloric diet of easily digested foods, and avoidance of stimulants.

A prescription for Dodd's lotion (pulv. zinc oxide dr. 4, glycerine fldr. 1, phenolis min. 30, aq. calcis [fresh] fl. oz. 8, Sig: Apply locally with a cotton sponge) is empirically given to be applied to the neck

TABLE IX

RESULTS OF ROENTGEN THERAPY IN HYPERTHYROIDISM
(From the Literature)

Author	Year	No. of Cases	Improved	Cured	Total Cured or Markedly Improved	Remarks
			per cent	per cent	per cent	
Pfahler	1908	51			82	
Fischer	1921	490			80	
Holmes and Means		44	60	37	97	
Sielmann	1923	328	44.5	50.5	95	12 per cent postoperative recurrences
Simpson	1924	200			70	
Saberton	1924	not given		75		
Read	1924	50	24	50	74	8 cases still under treatment 3 cases not traced
Jenkinson	1925	400			80	0-Myxedema 0-Parathyroid injury 0-X-ray burns
Allison	1925	175				
27 consecutive			11	78	89	
Hardman	1926	60	22	75	97	
Moorhead	1926	51	13	63	76	
Stumpf	1926	not given			90	
Sanger	1926	50				
	Goiter-Exopth.		6	82	88	
Webster	1926	107			82	
Stevens	1926	100			75	
Grier	1927	98	12	55	67	17 patients stopped treatment before sufficient treatment was given. These are counted with failures and reduce percentage
		86 (reported)				
Barclay and Fellows	1927	300	25	63.3	88.3	5 per cent no improvement 6.6 per cent not traced
Holzknecht	1928	not given	20–30	60	80–90	
Meyer	1928	328	18	66	84	
		263 Graves' disease				
Groover, et al	1929	305	8.5	88.8	97.3	2.6 per cent unimproved; 1.3 per cent reccurrences; 8.5 per cent cases were postoperative recurrences; 2 per cent telangiectasis; 1.3 per cent subsequent hypothroidism
Pfahler and Vastine	1929	326	30.5	57.5	88.0	Cures average over 6 yrs. 25 cases unknown

twice daily for three weeks following treatment in an effort to avoid skin damage. The patient is given a printed slip cautioning against sunburn or irritating salves and lotions.

SUMMARY OF RESULTS OF ROENTGEN THERAPY IN HYPERTHYROIDISM

We have treated 327 cases of hyperthyroidism, in 25 of which the subsequent result is unknown after one or two treat-

ments. Of the remainder there are 173, or 57.5 per cent, definitely cured for an average of over six years. Ninety-two cases, or 30.5 per cent, are markedly improved and 36 cases, or 12 per cent, are only slightly improved or without improvement at all. Of this series, 25 required subsequent surgical removal of the goiters either because of failure to obtain a response with irradiation or because of a small remaining adenoma.

There were 2 post-irradiation recurrences. This is 0.7 per cent of all cases, or 0.75 per cent of the cases cured or markedly improved. In 4 cases, or 1.3 per cent, the metabolic rate was subsequently less than normal. In only one of these patients is thyroid extract now necessary to relieve symptoms. In 14 cases there were degenerative skin changes such as dryness and telangiectasis. Tanning was not infrequently seen but this usually disappears and is of no significance. Twenty-two of our cases were postoperative recurrences, of which 17, or 77.5 per cent, were either cured or markedly improved and 5, or 22.5 per cent, were not improved.

In 12 cases definite substernal goiters could be recognized. This does not include the numerous low cervical goiters in which the lower border extended slightly beneath the sternum. Of these 12 cases a disappearance was effected in 5, or 45.5 per cent, decrease in size in one, or 9.0 per cent. No change was seen in 5, or 45.5 per cent. The result in one case in unknown.

Our results, obtained by a technique which is now fairly standard, correspond quite closely with those obtained by other roentgenologists, as shown in Table IX. This includes over 3300 cases of which an average of 85 to 90 per cent have been cured or markedly improved. For fear of overlapping, this table does not include the 1788 cases gathered from the literature by Krause, nor the review of over 5000 cases gathered from the literature by Soiland.

CONCLUSIONS

Our observations and those of other roentgenologists in treating rather large series of cases of hyperthyroidism permit us to conclude that roentgen therapy offers as great prospects of cure or marked improvement as can be obtained by any other known means. In cases causing pressure or embarrassment of respiration, surgery is indicated. In non-toxic cases, we recommend surgical or medical treatment depending upon the type. When medical treatment fails and surgery is refused, these non-toxic cases may be given several small series of treatments, with little danger of impairment of the normal function of the gland.

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DISCUSSION

Dr. T. A. Groover, Washington, D. C. I wish to congratulate Dr. Pfahler and Dr. Vastine upon the presentation of their statistics in the treatment of hyperthyroidism. That is exactly what we need to establish this methtod of treatment upon a firm basis. As you well know, the surgeons have accumulated very large statistics with respect to the surg-

ical treatment of goiter in comparison with which the statistics of the roentgenologists are comparatively meager. Like Dr. Pfahler, I have been interested in this subject for a good many years, and recently when we analyzed our cases and published the results in the *Journal of the American Medical Association*, they paralleled very closely those of Dr. Pfahler. There are, it is true, minor differences in the figures which are very readily reconciled when taken into consideration with the text of the two articles. For instance, I feel sure that we included in our statistics of cures some cases which Dr. Pfahler and Dr. Vastine included as improved. In considering the cure, we took into consideration the relief of evidences of toxic manifestations such as elevation of metabolism and the usual clinical symptoms which go along with thyroid intoxication. Of course many of these patients have had damage to the myocardium or other visceral changes which remain after the thyroid intoxication is completely relieved.

It has been important, too, to establish the permanence of cure from roentgen therapy, as that has been so frequently denied. For many years we have made it a practice never to discharge a patient whom we have treated for hyperthyroidism and the result has been that we have been able to keep most of our cases under observation for a prolonged period of time. Dr. Pfahler has done the same thing, so I know we can state with reasonable certainty that the cure of hyperthyroidism by roentgen treatment is at least as permanent as it is by surgery.

It is quite true that there will perhaps always be a small residue of cases that will not be cured by any treatment, either x-ray or surgery, but certainly there will be quite as many recurrences and failures following surgical treatment as there are following roentgen treatment.

One of the most important criteria for judging the cure of hyperthyroidism is the weight curve. It is important because it is the one criterion about which there can be no argument as to accuracy. In going over our cases, we were struck with the consistent gain in weight of these patients. There was an average gain in our series of cases of 16½ pounds per patient. I consider that perhaps even of more significance and importance than I do the basal metabolism. I feel sometimes that undue significance is attached to the basal metabolic rate as contrasted with the clinical manifestations of the disease. Certainly the two ought to be correlated, and neither disregarded. I think that sometimes patients with a reported increased basal metabolism or a reported normal metabolism, as the case may be, are treated or dismissed without proper clinical consideration. We do know that there is a great chance for error in the determination of basal metabolism. For instance, I have had patients examined by a number of different physicians on successive days as to the basal metabolic rate, with very wide variation in the results, and while I consider the basal metabolism of importance, I consider the careful clinical evaluation of the signs of thyroid intoxication of a great deal more importance.

I want to add only one more word. I consider that the medical supervision and management of these patients in conjunction with the roentgen treatment is of inestimable importance. If these patients are very toxic, we insist on their going to bed. It is also important to eliminate as far as possible any foci of infection, such as abscessed teeth or diseased tonsils, which ought to be eradicated as far as possible, always giving consideration to the hazard which any sort of an operative procedure entails in these patients. However, I have about reached the conclusion that when a patient is referred to us for the treatment of hyperthyroidism and does not respond in a satisfactory manner, I have overlooked some important contributing factor and by working a little harder to find out what that contributing factor might be, we can frequently turn an apparent failure into a complete success. For instance, in a recent case which had not responded as satisfactorily as it should, we found that we had overlooked careful attention to the mouth, and when several abscessed teeth were removed, the patient went ahead and got entirely well.

Rest and general hygienic management, psychic and otherwise, are of the greatest importance, and I believe that if we pay close attention to all of these contributory factors, we can materially increase our percentage of complete cures.

Dr. Pfahler (closing). I want to thank Dr. Groover for his excellent discussion. Some of the points emphasized by him are brought

out in the paper but were not presented because of lack of time.

In treating a hyperthyroid case, we must not forget that the patient may have associated heart disease or some other associated disease and we cannot expect that just because we treat the patient's thyroid and perhaps get rid of the toxic symptoms that we are also curing every other symptom from which the patient is suffering. An appropriate treatment must be given for whatever other condition the patient is suffering from. That is often forgotten, especially by specialists in any line of practice. They seem to think that the particular thing that they do, and sometimes the patients think that the particular thing that the specialist does, should relieve every symptom and every complaint.

THE TREATMENT OF CARCINOMA OF THE BODY OF THE UTERUS*

By WILLIAM NEILL, JR., M.D.
BALTIMORE, MARYLAND

ADENOCARCINOMA of the body of the uterus is rarer than cervical cancer, grows more slowly, and tends to remain restricted to its primary corporal origin. Metastases to distant or neighboring structures, however, are more common than in the cervical group. The ratio in our clinic is 1 to 14, while in the Gynecological Department at Johns Hopkins it is approximately 1 to 35.

It is my present purpose to emphasize our treatment of this disease with radium, reporting results and the percentage of five year cures.

The cause, as in cancer elsewhere, is unknown, chronic irritation apparently playing a less important part than in cervical cancer. There is no evidence that heredity plays a rôle. It is an affliction of later life. In 163 cases seen at the Howard A. Kelly Hospital, the average age was fifty-five, the oldest being eighty and the youngest twenty-eight. In a group of 333 at the Mayo Clinic, Stacy found 10 per cent under the age of forty-five. In our series, 11 per cent were under this age.

I have been unable to find available statistics as to the influence of race on this type of cancer. Lee states that cancer of the uterus, or elsewhere, is seldom, if ever, found in a full-blooded American Indian. Cancer in the Mongolian is known to be very commonly located in the pelvis. We see a large number of negroes at our clinic but find only two in our entire group of 163, while cervical cancer is more prevalent among the negro than in the white race.

It seems to be pretty generally accepted that myoma is a frequent complication. In our series, fibroids appeared in but 12 per cent, and the preponderance of the impacted type was no greater than of the freely movable. Stacy, in 269 cases where hysterectomy was performed, reports fibroids in 33 per cent; while Norris and Vogt found 21 per cent. Ewing, quoting Kolb, states that 50 per cent of all women over the age of fifty have fibroids, and that 20 per cent of all over thirty-five are so afflicted. Uterine fibroids are notably more common in the negro than in the white, while body cancer is rarer.

In the early development of cancer of the body of the uterus, the predominant symptoms are leucorrheal or watery discharge and bleeding. Severe hemorrhage is rare. Such initial symptoms, present for months without pain or discomfort, lead the patient to believe that there is no serious trouble, and so delays her appeal to the doctor until the characteristic disturbances of the later stages of the disease are becoming apparent. Excessive menstruation is usually the rule in the premenopausal stages; the vast majority, however, occur after the climateric. The same symptoms are common to a variety of diseases, such as polypoid endometrium, polypi, submucous fibroids, vaginitis, and inflammatory conditions.

An accurate diagnosis is easily made by due attention to the history, coupled with a physical exploration. Inspection and bimanual palpation easily differentiate conditions of the vaginal wall arising from the cervix; but vaginal metastasis from a carcinoma of the body of the uterus is common and the disease above may be overlooked. A roentgen examination of the chest is routine in each case. It is impossible to place too much emphasis on the importance of curettage and microscopic study of the tissue removed. In our clinic, no cancer of the body of the uterus has

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excaped recognition, so far as we know. Occasional cases sent in and diagnosed elsewhere as malignant, without microscopic examination, have proved to be benign. Serious infection has not followed the instrumentation necessary for microscopic examination and there is no evidence that it has precipitated a spread of the disease; and the diagnosis as well as the grade of malignancy is definitely established. Grades 2 and 3 are commoner, following Broders' classification. Of 126 accurately graded, 18 were grade 1, 41 grade 2, 34 grade 3, and 24 grade 4.

For convenience, the cases have been divided into early operable, borderline inoperable, the recurrent after operation, and the metastatic.

When the disease is limited to the uterus, there are two possible methods of successful treatment: a radical operation, as recommended by surgeons the world over, and radium. Operation is safe and satisfactory, and is preferable, in the absence of any well-defined contraindication—especially as one cannot always determine whether or not the disease has extended through the walls of the uterus to the peritoneum. In our series of 27 cases the mortality by abdominal hysterectomy was 9 per cent. Stacy, in a series of 239 cases from the Mayo Clinic, reports a mortality of 6 per cent. The general average from the literature is quoted to be from 6 to 15 per cent.

Recently, Stacy, Heyman, and others, have reported results in treating early cases with radium alone, which indicate the possibilities of this agent. Heyman, in particular, records a five year cure rate equaling that obtained by surgery, but still feels that, in the absence of complications, operation is the method of choice.

In the remaining more advanced groups there is little to be expected from surgery alone, but there still is a definite hope for prolonged palliation, and even a definite cure, with radium.

TECHNIQUE OF IRRADIATION

Our main reliance is on intrauterine treatment. There has been no mortality or serious complication. The radiation is from radon, contained in a glass bulb, surrounded by 1 mm. of brass and 2 mm. of rubber so that only gamma rays are emitted. From 1 to 2 curies, contained in from 4 to 6 tubes, are employed. Strings are attached to these and they are inserted into the uterine cavity so as to thoroughly cover the entire canal. From 2000 to 2500 mc-hr. is given in a single dose. This is given under a light anesthetic, preceded by a thorough exploration of the uterine cavity with both sound and polyp forceps. On completion of the treatment, the patient is kept in the hospital for three or four days, and then is given instructions to rest in bed for one week upon returning home. Aside from nausea and malaise, rarely lasting over forty-eight hours, there are, as a rule, no other discomforts. After three months, a second curettage is done and no treatment is given if the tissue is negative. If there is still evidence of malignancy, the question of further irradiation or operation is decided upon. Roentgen irradiation to the iliac glands and pelvic wall supplements this treatment. The roentgen treatment should be given with exactness, for there is a definite danger of injury to the intestines when combined with the heavy intrauterine exposure.

In the extensive inoperable and metastatic group, the treatment varies with the individual patient. Treatment is mostly by crossfire surface irradiation, best given with the roentgen ray unless several grams of radium are available.

The irradiation of postoperative cases should be carried out with great care. Often a loop of bowel will adhere to the vaginal scar, and application directly to the vaginal vault should be mild, the lower vaginal cavity, where metastasis often occurs, receiving the heavier dosage. Otherwise, the treatment is by surface

application as mentioned above. Frequent follow-up examinations are carried out.

RESULTS OF TREATMENT

From the literature, I could obtain but few definite data as to the percentage of five year cures in carcinoma of the body of the uterus. Heyman, collecting the results from a number of clinics, reports 58 per cent in 323 operations. By radium alone, he reports 50 per cent five year cures in 52 cases. Clark reports 42 per cent and Norris 44 per cent three year cures by operation. Stacy, in 215 cases, reports 50 per cent four year cures by operation, and in 25 cases treated by radium alone all but 2 have died of the disease within five years.

Our own cases are reported by groups, the first being *operative or early*. Here a subdivision into operation alone, radium alone, and operation and radium combined, is made. As stated above, it has been our practice in the past, when the patient's condition permitted, to treat by operation alone, or combined with radiation. Those treated by radium alone presented definite symptomatic complications which made surgery hazardous. The majority of these complications were old age, corpulence, high blood pressure, cardionephritis, and diabetes. Two patients were normal otherwise physically but refused operation; 11 were treated by operation alone, 46 by radium alone, and 16 by radium and operation.

Of the 11 cases treated by operation alone, 3 are living and well for over five years; 5 are living for less than five years and while free from symptoms are still under observation; one died from the operation; one from a recurrence of the disease; and one was lost sight of—making the operative cure rate 50 per cent.

Of the 46 cases treated by radium alone, 19 have been under observation less than five years and will not be counted in this estimation. Of the remaining 27, treated five years ago or longer, 15 are living and well; 7 died of the disease, and 5 from conditions not related to the original complaint. Of the 15 alive and well, 5 have lived for over five years; one for six years; one for seven years; one for eight years; 4 for nine years; 2 for ten years; and one for twelve years. Of those dying of the disease, all developed metastases. One lived for one year; 2 for two years; 2 for three years; and one lived for seven years after the treatment but ultimately died of the disease. This gives a five year cure rate of 55 per cent. If we included those known to have died from diseases other than cancer, the percentage, naturally, would be higher.

Of the 16 cases treated by a combination of operation and radium, 3 have been treated less than five years and will not be counted. Of the remaining 13, 9 are alive and well after five years. One of these, however, had a recurrence which cleared up with subsequent radium treatment; 2 died of recurrence and one died from the operation. The other case was lost sight of, a percentage of 69.

Advanced Inoperable Cases. A large number of these were given only palliative treatment. Omitting 15 treated less than five years, there remain 31 of these cases. Four have been lost sight of; 16 died in less than two years, 3 in less than three years; and 3 in less than four years. One patient lived five years, dying of the disease. Four are living and well five years. This gives a five year cure rate for this group of 13 per cent.

Recurrent After Operation. This group comprises 30 cases; 6 were lost sight of; 20 died of the disease within two years; one has been living and well for three years. Of those cured, one has been living six years; one for seven years; and one for nine years. This gives a five year cure rate of 12 per cent.

Advanced Cases With Metastases When First Seen. There are 11 cases in this group. There were no cures. All were in the advanced stages and in none was the attempt made to treat the entire disease, but only to relieve the main complaint—pain. Some

we were able to make more comfortable but none lived over two years.

COMMENT

Taking all groups treated at the clinic prior to five years ago, there were 109 cases; 76 have died—counting the 6 cases lost sight of as dead—and 33 are living, making a total five year cure rate of 33 per cent.

This study has not attempted a prognosis from the standpoint of histological grading. We have observed extensive metastases in cases classified as grade 1, and some of the cases in grade 4 have remained local for a long time. I know this to be true also in carcinoma of the cervix and in tumors of the bladder.

CONCLUSIONS

As with cancer elsewhere, the greatest hope for cure lies in an early diagnosis.

In operable carcinoma of the body of the uterus, radium offers a method of treatment comparable to surgery. It obviates the primary mortality and can be used safely in those presenting bad surgical risks.

Radium offers the possibility of a cure and definite palliation to a number of inoperable and recurrent cases.

When there is any doubt as to the extent of the disease, operation alone or combined with radium is the treatment of choice.

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DISCUSSION

Dr. William P. Healy, New York City. This is a splendid and very unusual report. It indicates end-results in a field of cancer where various methods of therapy have been carried out, and we know in individual instance well carried out, whether it was by operation alone, where the surgery was done by the best technique, or by radium alone or a combination of both methods. The patients were in the hands of experts at all times. Therefore, we must assume that these figures represent probably the best figures that could be obtained for the treatment of this type of cancer.

It has been known that radium has had little, it any, value in the treatment of cancer of the corpus uteri, except in the advanced or hopeless cases, My own attitude of mind on the subject until recently can be stated briefly. Most of these patients are beyond the menopause when they come to us and have been free of uterine bleeding for some time. Then they notice bleeding, which we find on examination is coming from the uterine cavity. The procedure advised in such cases was always diagnostic curettage, and if examination of the material obtained by the curette indicated that we were dealing with cancer of the corpus uteri, we tried always to obtain the patient's permission to proceed at once with abdominal hysterectomy, unless there was some definite contraindication to that procedure. That was our invariable plan until recently, but a year or so ago Dr. Max Cutler and I reviewed a number of our corpus cases that had been treated three to five years previously. We reviewed these cases with an absolutely open mind as we wanted to see if there was anything important in the findings.

We took the lead of Mahle of the Mayo Clinic, who had published a splendid paper, and of Dr. Stacy also, but Mahle had charted his tumors into four histologic groups and we did the same with ours. We found, as he did, that they could be grouped into four classes.

This first group, known as papillary adenoma malignum, grade I, presents a lesion of very low grade malignancy, but nevertheless cancer. We found these cases were very easily cured by curettage in many instances, and when the uterus was removed a few weeks later the pathologist found no evidence of carcinoma. This group can be cured by irradiation, by hysterectomy, or any other available method of procedure.

The second group, known as adenoma malignum, grade II, shows that the gland spaces are more infolding; it is more malignant than the preceding group, but still there is no breaking through of the cells into the stroma. This group is definitely curable by radium applied directly within the uterus, or by hysterectomy.

The third group is known as adenocarcinoma, grade III. Here we have gone definitely further into fully developed adenocarcinoma. There are definite masses of cancer cells through the stroma rather than in the gland structure. This is a very serious disease; much more so than any other group we have in cancer of the corpus uteri. No matter how it is treated, according to our studies, whether by hysterectomy, radium, or a combination of these, the results are disappointing.

The fourth group is known as anaplastic adenocarcinoma, grade IV, and is a very malignant carcinoma arising from the glands. It is exactly, under the microscope, like the anaplastic growth of the cervix. This type responds well to radiation therapy. This also shows, according to embryonal cell type, the most malignant type of growth, but it behaves differently to radiation than the third group.

Of the papilloma malignum cases 98 per cent have remained well. In the second group 65 to 70 per cent have remained well for five years. In the third group only 18 per cent have remained well. In the fourth group 6 to 12 cases are still alive, giving us 50 per cent in that group.

The important thing, we think, is that in three different institutions, in different parts of the world, where radiation treatment was carried out on operable cases of cancer of the corpus uteri we have an average of 58.5 per cent cures, which is certainly as good as surgery can show in carcinoma of the corpus uteri.

So, since we found that radiation therapy was apparently very important in the treatment of these cases, and since we found there was an anaplastic type of cancer originating in this region, we have changed our treatment in these groups to the application of radium followed by high voltage roentgen rays, and then in five or six weeks we do an abdominal hysterectomy. We have been doing this for one year in all cases in which operation was not absolutely contraindicated. During this period it has been amazing to us to note how frequently when we remove the uterus six weeks after the irradiation the pathologist has found no carcinoma. It seems to have been cleared up with the treatment. As a rule, we never give over 3,600 or a maximum of 4,000 milligram-hours within the uterus plus the high voltage cycle, and then in six weeks do the hysterectomy.

I think the field for irradiation in cancer of the corpus uteri is better than we realized, but I believe cancer of the corpus has to be regarded as primarily and largely a surgical disease. I would not wish to omit hysterectomy from our therapeutic procedure, certainly not in the third and fourth groups. I would be willing to omit it in selected cases in the second group, and would omit it completely in the first group.

Dr. Leda J. Stacy, Rochester, Minn. In the paper which I read two and a half years ago I noted that those patients in whom the carcinoma of the fundus was associated with fibroids had had symptoms for a longer time than those not having fibroids. This is probably due to the fact that the symptoms were misinterpreted and the metrorrhagia was erroneously thought to be explained by the fibroids. Carcinoma of the fundus occurs more frequently during the menstrual life than it was previously thought as 10.5 per cent of the patients were between the ages of forty-five and forty-nine, and 10.5 per cent were less than forty-five years of age, though in the group reported in the paper quoted by Dr. Neill 63 per cent of the patients had ceased menstruating. The youngest was nineteen years of age. The patient of nineteen years was operated upon nine years ago and is still alive and well.

I wish to correct Dr. Neill in quoting my percentage of five year cures as our statistics show that 63.88 per cent had lived more than

five years following the operation, and of the 288 persons heard from 53 per cent are still living, all more than five years after the operation. Of the 79 patients heard from who had been operated on 15 or more years previously 29 per cent were still living.

The point Dr. Neill brought out about the cases of grade IV carcinoma giving better results is interesting. The same observation was made in reviewing our statistics and I think this may be explained by the fact that in the grade IV cases the growth is proliferative and bleeds more readily, thus producing symptoms which attract the patient's attention earlier than the infiltrating type of growth which may be of considerable extent before producing symptoms.

I was much interested in Dr. Neill's and Dr. Healy's reports regarding the results following radium and roentgen treatments in carcinoma of the fundus uteri. At the Mayo Clinic we operate upon all cases of carcinoma of the fundus of the uterus unless there is definite contraindication to operation. A number of patients have received roentgen and radium irradiation preliminary to the hysterectomy while being prepared for the operation and in one or two instances carcinoma was not found in the removed uterus.

I think the difficulty one might encounter in treating carcinoma of the fundus with radium would occur especially in those cases in which the carcinoma has developed at the base of a polyp, and it is in this type that one can expect excellent results following the hysterectomy.

Dr. Neill (closing). I wish to thank Dr. Healy and Dr. Stacy for their important discussions. We have not been doing a hysterectomy following irradiation, as has Dr. Healy, but let the radium stand on its merits, being fearful of stirring up some lingering island of inactive disease not detected on palpation. Rectal examination is indispensable in determining the extent of involvement in the lateral structures, it being impossible to estimate this by vaginal examination alone.

THE DETECTION, ESTIMATION AND ELIMINATION OF RADIUM IN LIVING PERSONS GIVEN RADIUM CHLORIDE INTERNALLY. II.

By HOWARD H. BARKER,
United States Radium Corporation,
NEW YORK CITY,
and HERMAN SCHLUNDT,
Professor of Chemistry, University of Missouri
COLUMBIA, MISSOURI

THE elimination of radium introduced into the human body by one of several methods began to command the attention of the medical profession about 1915, and has more recently been studied and discussed as a result of the so-called "radium poisoning" cases.[8,9] The earlier investigations were conducted primarily with regard to the frequency with which radium must be introduced into the system in order to maintain a fixed quantity, and further to develop a type of radium preparation which when once introduced would remain there for a sufficiently long enough period to have some effect. Seil, Viol and Gordon[11] studied the elimination of soluble radium salts taken intravenously and per os by man over periods of five to twenty-one days after administration. They computed the elimination by collecting the feces and urine and determining quantitatively the amount of radium contained, and by knowing definitely the amount originally administered they could calculate the rate of elimination from day to day. They report that from 25 to 35 per cent of the radium taken by mouth remains in the body four or five days after ingestion, while from 55 to 65 per cent of the radium injected intravenously remains after four or five days, and that the rate of elimination in both cases is about the same from that period on. After the tenth day they found the amount eliminated to be less than 1 per cent per day.

In the interim between 1910 and 1913 Dominici and his associates[1-5] published considerable work relative to the fixation and duration of radium salts, both soluble and insoluble, in the system of animals—a horse and rabbits—when injected intravenously and intramuscularly.

More recently several references have been made to the rate of elimination, but most of them have lacked sufficient experimental data to be convincing. Flinn[6] checked the rate of elimination where radioactive luminous zinc sulphide was fed to guinea pigs, and reports that approximately 98 per cent of the radioactive material was excreted within a few days after the ingestion had ceased. Flinn and Seidlin[7] report rather phenomenal results in the increased rate of elimination among some of the radium cases, with the use of parathormone treatment. Apparently with the administration of parathormone repeated, extending over periods of two to five months, nearly 50 per cent of the radioactive material which had been held fixed in the system for five years or longer was eliminated during the treatment. Since a close connection between calcium and radium elimination is generally assumed, these experiments present an amazing reduction and exchange of calcium compounds in the system, unless one makes the bold assumption that parathormone exercises a specific therapeutic action on radium fixed in the bony skeleton.

Progress has been handicapped because of lack of living subjects for careful study over prolonged periods of time, and the authors, therefore, feel that they have been exceptionally fortunate in having the cooperation of a group of medical men who have for four or five years administered radium chloride internally—that is, either intravenously, intramuscularly or per os,

for it was through their cooperation that we were able to examine and collect the data on the cases herewith reported.

As will be shown later, some of the cases examined were given radium chloride internally four or five years prior to the examination, others one or two years before, while others were being given the material currently at the time of examination.

Naturally, the first object of our examination was to ascertain whether or not radioactivity could be detected in the subjects by electroscopic tests, and at the same time to determine the approximate quantity of radium present. In conducting the tests we followed fairly closely the method described by Schlundt, Barker and Flinn.[10] For the detection of the penetrating radiation we employed the same gamma ray electroscope,—a Wulf-Hess quartz fiber instrument used in our former work. Two new Lind ionization chambers, each of 2700 c.c. volume, and a new electroscope head were used for the detection and estimation of radium in the expired air from the subjects. Since all the instruments employed had been calibrated in terms of radium units our experiments enabled us to express between certain limits the quantity of radium present in each subject found radioactive. In cases where no radioactivity was detected, the tests were negative by both the gamma-ray instrument and the expired air method of detecting radium in living persons.

The experimental data obtained are given in condensed form following the record of doses of radium chloride for each patient. The activity detected by the gamma-ray test, plus the activity of the expired air, represents the total quantity of radium present in the patient at the time the test was conducted. All cases reported were examined Nov. 9 to 10, 1929. The clinical data, as well as doses of radium administered in these cases were supplied by the medical men in attendance, which together with the radioactivity of the patients are summarized in tabular form. All radium values are expressed in micrograms, μg. (1 μg. = 10^{-6} g. Ra element).

EXPERIMENTAL PART

Case I. Female, aged sixty-five, a physician specializing in obstetrics. When first seen in June, 1927, patient had a very bad myocarditis, intermittent heart, diabetes, 10 per cent sugar, 9 pints urine in twenty-four hours, 3 plus acetone and diacetic acid. Radium chloride to be taken orally was prescribed. For approximately four months the patient took 1 dram radium chloride solution daily, containing 3 μg. of radium element. The dosage was then reduced to 1/2 dram daily, which the patient continued taking more or less regularly up to date of examination.

DATES AND TYPE OF ADMINISTRATION
All Radium was Administered Orally

	1927	1928	1929	
Jan.		100		
Feb.				
Mar.				
Apr.				*Summary*
May		100		1927— 955μg.
June	265			1928— 300μg.
July	270		100	1929— 200μg.
Aug.	120			
Sept.	200			Total—1455μg.
Oct.	100	100	100	
Nov.				
Dec.				
Totals	955	300	200	

Radioactivity Nov. 9, 1929 (1.5μg. radium taken 3 hrs. before test)

By gamma-ray test	2–4μg. radium
By expired air test	2.5–4μg. radium
Total	4–8μg.

Case II. Male, aged fifty-seven, employed as outside salesman. When first seen in August, 1924, there were marked gastric disturbances and epigastric pains. Eighty μg. of radium element was given intravenously in 10 μg. doses, at five to seven day intervals. At the same time radium was taken orally, and continued after the intravenous treatment.

DATES AND TYPE OF ADMINISTRATION

	1926		1927		
	Oral	Intra.	Oral	Intra.	
June			60		*Summary*
Aug.	60	50			1926—320μg.
Sept.	60	30			1927— 60μg.
Oct.	60				
Nov.	60				Total—380μg.
Totals	240	80	60		

Tests for radioactivity were negative.

Case III. Female, aged forty-nine, housewife. Patient displayed multiple arthritis and some myocarditic disturbances, as well as intermittent heart. She was given 70 μg. of radium element intravenously in 10 μg. doses, at five to seven day intervals. Radium chloride was taken orally at the same time and continued after cessation of intravenous treatment.

DATES AND TYPE OF ADMINISTRATION

	1927		1928	
	Intra.	Oral	Oral	
Jan.				
Feb.			20	
Mar.				*Summary*
Apr.			20	1927—190μg.
May			20	1928— 60μg.
June				
July				Total—250μg.
Aug.				
Sept.	40	40		
Oct.	20	40		
Nov.	10	40		
Totals	70	120	60	

The gamma-ray test for radioactivity was negative. The expired air test showed slightly radioactive, but at best a mere trace.

Case IV. Male, aged sixty-five, attorney. Patient first came under observation in 1924—had a 4+Wassermann reaction; hypertension and glycosuria. During 1924 and 1925 was given two series of treatments of 9 gm. neosalvarsan, followed with mercury and bismuth in the usual manner. Wassermann remained 4+. In 1927 the patient received another course of neosalvarsan, followed with mercury and bismuth, also radium administered intravenously.

DATES AND TYPE OF ADMINISTRATION
All Radium was Administered Intravenously

	1927	1928	
Feb.	40	200	
Mar.	40	250	*Summary*
Apr.	50		1927—440μg.
May	10		1928—450μg.
Nov.	150		
Dec.	150		Total—890μg.
Totals	440	450	

Radioactivity

By gamma-ray test	10–18μg. radium
By expired air test	9–15μg. radium
Total	19–33μg.

Case V. Male, aged thirty-eight, accountant. Patient was first seen in 1929, and was a case of dementia praecox. Eighty μg. of radium element in the form of chloride was administered intravenously in 10 μg. doses, at five to six day intervals.

DATES AND TYPES OF ADMINISTRATION

	1929 Intravenously
Jan.	
Feb.	50
Mar.	20
Apr.	10
Total	80μg.

Tests for radioactivity were negative.

Case VI. Male, aged seventy-five, real estate business. Patient had phlebitis of left leg, and intermittent heart, also myocarditis. During 1924, 240 μg. of radium element was administered intravenously and orally over a period of approximately four months. Tests for radioactivity were negative.

Case VII. Male, aged fifty-four, practicing dental surgeon, also M. D. When first seen in fall of 1926, patient had myocarditis, intermittent heart, bad cough and night sweats, also hypotension. A course of radium treatment

was administered intravenously in 1926 and 1927, after which the general condition was much improved, and remained good until the summer of 1929, when there was a recurrence. Another course of radium was administered intravenously—the last dose was given approximately two weeks prior to our examination.

DATES AND TYPE OF ADMINISTRATION
All Radium Administered Intravenously

	1926	1927	1928	1929	
Jan.				20	
Feb.				30	
May		30		10	*Summary*
June		10		10	1926— 60μg.
July		20			1927—110μg.
Aug.		10		20	1928— 20μg.
Sept.				40	1929—140μg.
Oct.	10	10		10	
Nov.	40				Total—330μg.
Dec.	10	30	20		
Totals	60	110	20	140	

Radioactivity

By gamma-ray test..... 5– 8μg. radium
By expired air test..... 4– 6μg. radium

Total..... 9–14μg. radium

Case VIII. Male, aged sixty-six, executive work. Patient was first seen in late summer of 1924. Had bad cardiac asthma. Was given 85 μg. of radium chloride at five day intervals in 10 μg. doses with 25 μg. to start. Another series of radium chloride treatments, administered intravenously, was given in 1929.

DATES AND TYPES OF ADMINISTRATION
All Radium Administered Intravenously

	1924	1925	1928	1929	
Jan.		30		20	
Feb.				20	
Mar.				10	
Apr.		20		20	*Summary*
May				10	1924— 85μg.
June					1925— 70μg.
July				10	1928— 40μg.
Aug.	55	20		10	1929—110μg.
Sept.	30			10	
Dec.			40		Total—305μg.
Totals	85	70	40	110	

Radioactivity

By gamma-ray test..... 5– 8μg. radium
By expired air test..... 4– 6μg. radium

Total..... 9–14μg. radium

Case IX. Male, aged thirty, butcher. First seen in May, 1924. Was treated for urethal gonorrhea. Case was given approximately 200 μg. radium element intravenously. Physician in charge died and case was taken over by another physician and radium treatment continued.

DATES AND TYPE OF ADMINISTRATION
All Radium Administered Intravenously

	1925	1926	1927	1928	
Jan.		60	40		
Feb.		30		60	
Mar.				60	
Apr.	20		120		
May	40		120		*Summary*
June	30		120		1924— 200μg.
July					1925— 240μg.
Aug.	60				1926— 170μg.
Sept.	60				1927— 400μg.
Oct.					1928— 120μg.
Nov.	30	40			
Dec.		40			Total—1130μg.
Totals	240	170	400	120	

Radioactivity

By gamma-ray method..... 5– 9μg. radium
By expired air method..... 5– 9μg. radium

Total..... 10–18μg. radium

Case X. Female, aged forty, clerical worker. Patient was operated on early in 1926 for duodenal ulcers. She became easily fatigued and caught cold readily—hypotension. Was given course of radium chloride treatment, both intravenously and orally.

Table 1 gives the data and information relative to the various cases in condensed form. All radium values are expressed in terms of micrograms, μg. (10^{-6} g. Ra element).

From Table 1 we note that 4 of the 10 cases examined were negative so far as the radioactive tests were concerned, and that one case showed a mere trace. It is, of

DATES AND TYPE OF ADMINISTRATION (CASE X)

	1926		1927		
	Intra.	Oral	Intra.	Oral	
Jan.			10	20	
Feb.			20		
Mar.			20	20	
Apr.			10		
May					*Summary*
June			10	20	1926— 45μg.
July					1927—162μg.
Aug.			20	12	
Nov.	15	20			Total—207μg.
Dec.	10				
Totals	25	20	90	72	

Tests for radioactivity were negative.

course, impossible to estimate the rate of elimination in these cases, but that the radium administered has been eliminated there is no question.

Cases I, VII and VIII had been given the material so recently prior to our examination that had we not detected the presence of radioactive materials in their systems we would have been surprised. However, considering the quantity of material taken orally by Case I, as well as the fact that she had taken a small amount the day the tests were conducted, it would seem from the small amount found that her rate of elimination must be very high. Cases VII and VIII contain quantities of radium well within the range of what might be expected, based on the work of Seil, Viol and Gordon.

Although nearly two years had elapsed between the last time Cases IV and IX had received radium chloride internally, and the date of our examination, they showed the largest amount of radium in their systems of any of those examined. In this connection, however, it is of interest to note

TABLE I

Case No.	Diagnosis	Ra. Given Orally μg.	Ra. Given Intravenously μg.	Total Ra. Given μg.	Period Since Last Treatment	Ra. Remaining in System μg.
I	Myocarditis, intermittent heart, 10% sugar, 3+ acetone and diacetic acid	1455	—	1455	1 day	4–8
II	Gastric disturbances	300	80	380	2½ yrs.	none
III	Multiple arthritis and myocarditis	180	70	250	1½ yrs.	mere trace
IV	4+Wassermann, hypertension and glycosuria	—	890	890	1⅔ yrs.	19–33
V	Dementia praecox	—	80	80	7 mos.	none
VI	Phlebitis left leg, myocarditis	120	120	240	5 yrs.	none
VII	Myocarditis, hypotension	—	330	330	2 wks.	9–14
VIII	Cardiac asthma	—	305	305	5 wks.	9–14
IX	Urethral gonorrhea	—	1130	1130	1⅔ yrs.	10–18
X	Hypotension	92	115	207	2 yrs.	none

that both of these cases had received large amounts of radium chloride internally, 890 and 1130 micrograms respectively, and that it had been given as a last resort to help conditions that had not responded to other types of medication. Case IV had a 4 plus Wassermann reaction and had had two courses of treatment with neosalvarsan, bismuth and mercury prior to the time radium chloride was given, and one course of neosalvarsan, bismuth and mercury concurrently with the radium chloride. Case IX was considered an incurable case of urethral gonorrhea at the time the radium chloride treatment was started, though practically every known medical remedy had been tried. These two cases are outstanding, and whether or not there may be some connection between their respective conditions and previous treatment given, and the fact that they have retained a fair amount of radium after approximately two years might be worthy of further investigation and consideration.

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THYROGLOSSAL DUCT CYST AND SINUS

A ROENTGEN STUDY

By PAUL O. SNOKE, M.D.
LANCASTER, PENNSYLVANIA

A GENERAL perusal of the literature on cysts and fistulae of the thyroglossal duct would lead to the conclusion that all fistulae or sinuses in the midline of the neck persisting after attempts at excision were draining from the unexcised thyroglossal duct. Sistrunk[6,7,8] reports successful excisions after coring of the duct but carefully states that "practically 100 per cent *should* be cured." Jones[2] and Schweizer[5] present two excellent roentgen studies but little else of value is to be found from the roentgenologic standpoint.

Jones suggests the use of gentian violet injection before operation to determine the extent of the sinus, but as every surgeon knows this has its distinct disadvantages. Roentgen study with opaque media offers an excellent field for the determination of the extent of these fistulae and sinuses.

EMBRYOLOGY

The emphasis laid upon the thyroglossal duct in anatomical, surgical and embryological teaching probably had its origin in the older anatomical works in which only the median thyroid anlage is stressed. Piersol[3] discredits the lateral thyroid anlage conception, but this work was published in 1907, five years before Wenglowski[9] published his epoch-making embryological studies. Wenglowski's work firmly establishes the existence of the lateral thyroid anlage and consequently their ducts (Fig. 1). If the median duct persists there is no reason why the lateral ducts should not persist.

We quote excerpts from conclusions 4 and 9 from Christopher's[1] translation of Wenglowski's article:

4. The branchial apparatus can not leave remnants in the neck below the hyoid.

9. The lateral thyroid lobes also have a short canal which disappears early. By analogy with the thymic duct one can consider that this canal may also persist and form fistulae and cysts.

The inner opening of such fistulae is found lateral to the entrance of the larynx.

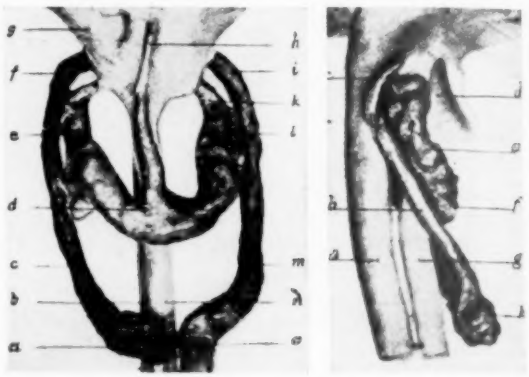

Fig. 1. Reproduction from Wenglowski's models of 14 mm. and 20 mm. embryos: (*a*) thymus; (*b*) esophagus; (*c*) duct of thymus; (*d*) thyroglossal duct; (*e*) lateral lobes of thyroid; (*f*) duct of thymus; (*g*) pharynx; (*h*) thyrolingual tract; (*i*) duct of thymus; (*k*) duct of lateral lobes of thyroid; (*m*) duct of thymus; (*n*) trachea; (*o*) thymus.

If this is correct then one might expect to find such a case clinically. The case we present suggests this possibility.

CASE REPORT*

A. B., aged thirty-four, white, single, female, was perfectly well until fourteen years of age (1909) when she noticed that a swelling developed in the submental and submaxillary region and extended down into the neck whenever she had an acute intraoral infection. Usually this subsided but on one occasion suppuration occurred and incision became necessary. At this time, an attempt to remove the cyst (?) was made and after a prolonged period of drainage the incision healed. Five years later (1914) a small sinus opened at the site of the original incision. Since that time, this sinus has persisted, a period of fourteen years.

* Reported through the courtesy of Dr. C. P. Stahr and from the X-Ray Department of the Lancaster General Hospital.

On Aug. 19, 1929, another unsuccessful attempt at excision was made, after which the patient was referred to the roentgenologist for such examinations as he thought necessary.

The patient was a well-developed young woman. The intraoral examination was negative. There was a transverse scar $1\frac{1}{4}$ inches long over the left thyroid cartilage in the center of which was the opening of a sinus, from which a thin mucinous material exuded (Fig. 2). This fluid was examined cytologically and for tubercle bacilli, diphtheria bacilli, actinomyces and salivary ferments, none of which were found. Dental roentgenograms were negative. Intermaxillary bite films were made in an attempt to find salivary calculi but were

Fig. 2. Note midline drawn in ink on throat. Sinus opens to left over thyroid cartilage.

negative. Roentgen examination of the neck in anteroposterior and lateral positions was negative.

Ordinary attempts to inject the sinus were unsuccessful until Dr. Paul Bishop of the Pennsylvania Hospital suggested inserting a ureteral catheter and using lipiodol. With this technique we were successful. The catheter was inserted 2.5 cm. (Fig. 3). The sinus extended upward to the hyoid bone and after investing it, divided into two tracts, a right and a left, which ran directly posteriorly and then curved upward and anteriorly into the

Fig. 3. Curved line represents ureteral catheter; the dash, point of entrance. Note distinct posterior direction of sinuses above hyoid and sharp curve upward and forward.

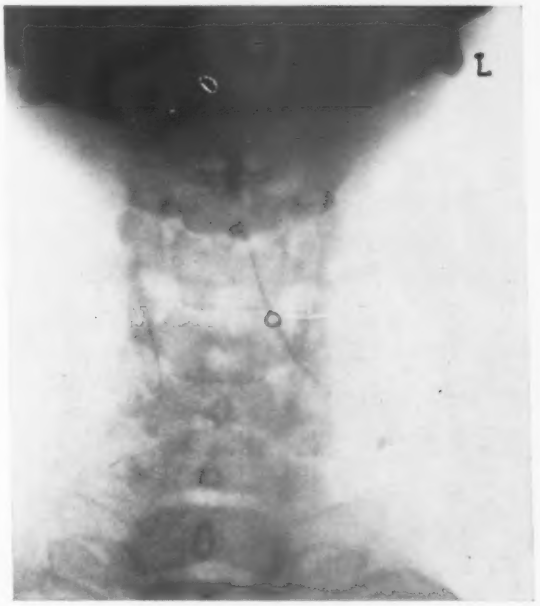

Fig. 4. Ureteral catheter is visible on the left. Circle is point of entrance into sinus. Hyoid bone lies at foot of Y. Left arm indistinct in reproduction.

floor of the mouth (Fig. 4). They did not communicate with the oral cavity as the patient did not taste the lipiodol. They passed in close proximity to both pyriform sinuses at the point Wenglowski concluded they should communicate with the pharynx.

COMMENT

The median thyroglossal duct proceeds posteriorly from the hyoid bone at an angle of 45° so that there can be no confusion with this duct (Fig. 5). The conclusion was reached, therefore, that these were lateral thyroid ducts which persisted as they were above the hyoid and united at their junction with the median duct.

Fig. 5. Normal course of thyroglossal duct. Plotted on a normal film.

The course after approximating the supposed embryologic destination is unusual but may be the normal course in the adult. The other possibility is that this was a very large cyst which ruptured, producing numerous ramifications.[4] This would be rather unusual as the sinuses are bilaterally symmetrical.

SUMMARY

A case of thyroglossal duct sinus is presented in which the lateral anlage ducts are believed to have persisted rather than the usual median duct.

Roentgen demonstration was made possible by the use of a ureteral catheter and iodized oil.

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SYPHILITIC INFECTION OF THE LUNG*

CASE REPORT

By HOWARD J. HUTTER, *Captain, Medical Corps. U. S. A.*
Roentgenologist, Army and Navy General Hospital
HOT SPRINGS NATIONAL PARK, ARKANSAS

SYPHILIS is such a protean disease that it is not surprising in its universal attacking of nearly every tissue throughout the body from the skin to the bone to find it manifested in the lungs. The difficulty of actually proving syphilitic infection of the lung in the past has accounted for the apparent rarity of this manifestation, though the probable truth is that syphilis of the lung is not any more unusual than syphilitic lesions involving the brain, the bone or the skin.

CASE REPORT

T. W. B., colored, aged thirty-two, ex-private, was admitted to the Army and Navy General Hospital, Hot Springs National Park, Arkansas, Jan. 11, 1928. He was a farmer, and had never been out of the United States. He gave a history of chronic malaria which was treated for two or three years, otherwise his family and personal history was irrelevant.

FIG. 1. Jan. 20, 1928. Note the marked consolidation right upper lobe, with central area of rarefaction. Note the destructive processes at the acromial ends of both clavicles. Palpation of this region failed to elicit much tenderness. There was no loss of motion at the shoulder joints.

He contracted syphilis in 1918 while in the Army and had a short course of antiluetic treatment. He also had gonorrhea, urethral, in 1918 and 1926. He had not been treated for

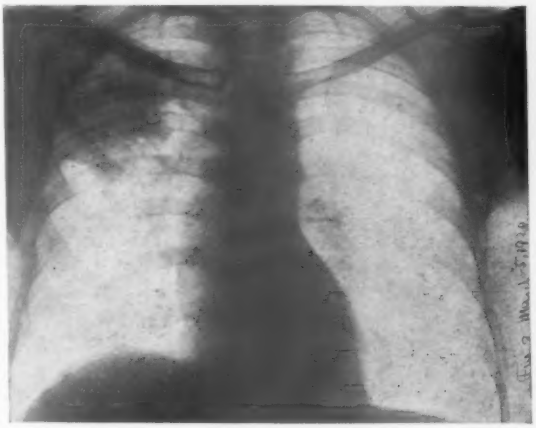

FIG. 2. March 5, 1928. Note how the area of consolidation in the right upper lobe has diminished in size.

syphilis since his discharge from the Army. His chief complaint was pains in the chest, which he said he had had for one and one-half years, with fever, constant coughing of blood, and loss of weight and strength.

Physical examination revealed an ambulatory male, height 65 inches, weight 108 pounds, normal weight 127 pounds, general condition fair. Pupils were equal and reacted to light and accommodation. The skin and mucous membranes, glandular system, and vascular system showed no evident abnormality. Blood pressure: 110/70. The heart was negative. Lungs: Harsh râles were heard in both upper lobes, with dullness and diminished resonance, and many moist râles in the right upper lobe. The genitourinary system showed a scar at the external urinary meatus, which just permitted a No. 18 diagnostic sound, evidently the scar from the chancre. The abdomen was negative. Nervous system:

* Published with permission of the Surgeon General, who is not responsible for any opinions set forth herein.

Fig. 3. June 18, 1928. The area of consolidation in the right upper lobe has diminished, leaving only fibrosis.

No Romberg; knee jerks active. Physical examination of the muscular system, bones and joints was negative.

The urine examinations, except for traces of albumin and a few hyaline casts, were negative.

The sputum was negative for tubercle bacilli twelve times from Jan. 21, 1928, to Feb. 27, 1928. It was negative twice in May, 1928.

Complete blood count, Feb. 13, 1928, showed slight secondary anemia, no malarial parasites. Blood Wassermann reactions were 2+ five times in January, 1928, also 2+ on Feb. 27, 1928. It was 1+ May 14, 1928. Spinal fluid, Jan. 16, 1929—cell count per c. mm. 16; globulin negative; Wassermann reaction, negative in all dilutions. Kidney function test and blood chemistry examination were normal.

Fig. 4. Jan. 27, 1928. Note the destructive process end of left clavicle.

Roentgen Findings. Jan. 20, 1928—"The right upper lobe, excepting the apex, is the seat of consolidation, fairly homogeneous with multiple areas of circumscribed rarefaction opposite the first interspace, quite likely the result of cavitation. Impression: Chronic pulmonary tuberculosis, moderately advanced, with cavitation. Elsewhere the lungs are clear. The existence of a gumma or an echinococcus cyst should be borne in mind before fully establishing a diagnosis, as it is difficult to believe from the roentgen appearance that this lesion is of long duration. Furthermore, the extremity of the left clavicle appears to be entirely destroyed, giving a blown appearance, which is sometimes seen in tuberculosis of the digit. The right clavicle at its outer extremity, gives a moth-eaten appearance.

Fig. 5. June 18, 1928. Left clavicle showing bone regeneration.

Further examination of the bones is indicated." Film taken Jan. 24, 1928—"The acromial ends of both clavicles show marked destruction; that is, starting from the medullary side, involving the cortex and periosteum. Elsewhere the bones appear normal." Jan. 30, 1928—"The upper lobe presents the same condition as previously reported. A gumma is to be suspected here. There is destruction of the acromial ends of both clavicles, with but little pain." Feb. 17, 1928—"Consolidation of the right upper lobe shows no further advance. It remains practically the same as previously described. Impression: Gumma of the right upper lobe." Feb. 23, 1928—"The mass is still present in the right upper lobe. I still believe it to be gumma." March 5, 1928—"The area of consolidation interpreted

as being a gumma in the right upper lobe is assuming a more fibrotic appearance and is evidently shrinking. Elsewhere the lungs are clear." March 21, 1928—"The gumma previously reported in the right upper lobe has considerably diminished in size. Furthermore, the destruction at both clavicular outer ends appears to be filling in." May 7, 1928—"There is marked pleural thickening in the right upper lobe. Opposite the 3d interspace is a circular rarefied area, diameter 4 cm., which is either a cavity or a pleuro-annular ring. There is beginning fibrosis radiating out from the hilus into the right middle and lower lobes. The condition is not characteristic of pulmonary tuberculosis. I still believe this is lung syphilis." June 1, 1928—"The pathologic lesion in the right upper lobe has diminished at least three-fourths from the first

Fig. 6. Jan. 27, 1928. Acromial end right clavicle with bone destruction. Also shows great increase in density in the right upper lobe.

report of last January, the destruction of the distal end of the left clavicle has filled in considerably. This is evidently a luetic process in the lung and clavicular ends." June 18, 1928—"The gumma in the right upper lobe is considerably resolved, leaving areas of fibrosis. The destroyed clavicular ends are filling in with new bone."

Treatment. Antiluetic treatment was started Jan. 26, 1928. Sulpharsphenamine, intramuscularly, in 0.4 gram doses every five days until nine doses were taken. Potassium iodide in increasing doses until fifty drops were taken three times a day. Mercury inunctions, one-sixth of an ounce, rubbed daily for thirty min-

Fig. 7. June 18, 1928. Shows acromial end right clavicle more clear cut, with increased aeration and diminished density in the right upper lobe.

utes, skipping each seventh day, thirty-six treatments. Discharged from the hospital March 20, 1928, for a rest; treatment resumed May 14, 1928, when he had at weekly intervals, up to July 7, 1928, arsenobenzol intravenously, 0.4 gram doses; bismuth salicylate, intramuscularly, in 1 c.c. doses.

Progress. The temperature was normal throughout. Weight increased from 108 pounds, Jan. 24, 1928, to 140½ pounds, March 13, 1928—a gain of 32 pounds over this period. On July 3, 1928, his weight was 137½ pounds. Discharged for a month's rest from treatment in April, 1928. Patient went absent without leave July 7, 1928.

COMMENT

This is a case of syphilitic lesion in the right upper lobe, probably a gumma. The sputum was repeatedly negative for tubercle bacilli. This patient gained 32 pounds under antiluetic treatment. The lesion in the lung practically disappeared after five months of specific treatment. Furthermore, the chronic osteomyelitis in both clavicular ends showed beginning regeneration of bone. The patient ran no fever during his stay in the hospital. With these facts in mind, there is no doubt that this is a case of tertiary syphilis, accompanied by extensive lesions in the right upper lobe and acromial ends of both clavicles.

A CASE OF RIGHT-SIDED RELAXATION OF THE DIAPHRAGM*

By DR. HANS FRITSCH
BIELITZ, POLEN

THE following case of elevation of the diaphragm is reported not only because of its rare occurrence on the right side, but also because the condition was observed over a number of years, thus permitting certain conclusions to be drawn.

CASE REPORT

The patient, male, aged sixty-seven, retired waiter, first came under our observation in September, 1920, complaining of shortness of breath, especially when walking rapidly or climbing stairs; pressure over the precordium, and dropped heart beats. He was small and delicate, with fragile bones, poor musculature and a thin panniculus; profuse growth of hair over face and scalp, sparsity of pubic hair; genitals small. Married thirty-two years; there were no children; no miscarriages. Denies venereal infection. No sugar or albumin in urine. Small thorax. No enlargement of heart detected by percussion or auscultation. Heart sounds distant, with accentuation of aortic second sound. The limitation of respiratory movement pointed to an elevated diaphragm on the right side. The blood pressure was moderately elevated.

The roentgen examination disclosed a somewhat accelerated, strong, heart action. There was no remarkable enlargement or change in shape. The shadow of the aorta was denser than normal and showed elongation with a pronounced arch. On the right side there was an elevation of the diaphragm which showed a difference of 5 to 6 cm. in height as compared with the left. The extent of respiratory movement on the right was slight as compared with the left side. No paradoxical breathing was observed. There was a dense adhesion at the inner edge of the diaphragm on the right. On both sides there were numerous hilus shadows showing partial calcification. The diagnosis at this time was: Increase in density of aortic shadow without appreciable widening; old indurated process at the hilus with calcification; elevation of the right diaphragm with adhesions at the inner edge of the diaphragm on the right.

In the following years I had numerous opportunities to examine the patient and found no appreciable change in his condition.

In January, 1925, while carrying a weight of 5–7 kg., the patient had an attack of dyspnea and severe precordial pain, so severe that he had to lie down immediately. The next day the symptoms had disappeared, the patient showing rapid improvement with rest in bed. Respirations normal; pulse, 72, strong, unequal and sometimes arrhythmic. The aortic second sound was accentuated and sharp; the other heart sounds were muffled and distant. Subjectively, the patient felt very well. He admitted that at other times previously, when carrying heavy loads, he had noticed a tired feeling in both arms.

Roentgenoscopic examination and films (Fig. 1) taken a few days after this attack showed a marked elevation of the diaphragm on the right on inspiration, with a difference of 10 cm.

FIG. 1.

* Read at the Fifth German Roentgen Congress at Prague. Translated from the German by Dr. Frederic Schreiber, Detroit, Mich.

between the level on the left and right sides. With ordinary breathing while standing, there was distinct paradoxical movement. In lying down the elevation of the diaphragm was more marked, but the paradoxical movement was absent and in this position there was a suggestion of normal breathing movements.

With the production of negative pulmonary pressure by an inspiratory act with the glottis closed, the right leaf of the diaphragm moved upward, the left downward (Wellmann phenomenon). On the right side also, there appeared two curved lines crossing at the outer and inner sides of the diaphragm. At the inner edge of the right diaphragm, could be seen the dense shadow of an adhesion, which was also visible in the lateral view as a cord-like structure. The left diaphragm moved well with respiration. At the top of this leaf there was a fairly well-circumscribed pouch measuring about 4 cm. at the base and about 1 cm. in height. Here, too, was seen a double arched line, crossing at the outer and inner sides. There were dense hilus shadows on both sides, especially the left. The lungs showed no appreciable changes. The heart had a slow, powerful rhythm. The size and shape of the heart shadow was within normal limits, though the left auricle and pulmonic arch appeared somewhat accentuated. The shadow of the aorta was more dense than normal. The aortic arch turned acutely to the left and was sharply curved. The shadow of the innominate was prominent. Diagnosis: Relaxation of the right diaphragm; atheromatous aorta without appreciable widening of the arch.

Following this attack, the patient experienced no difficulty when he followed instructions and obtained his necessary rest. In 1926 I moved from Teschen to Bielitz and lost sight of the patient. I was told that he died in 1927, probably of pneumonia following exposure to cold. No autopsy was held.

COMMENT

In considering the cause of the one-sided elevation of the diaphragm in this case, the diminished tonus of the diaphragm was due either to injury to the phrenic nerve, or as a result of fatty degeneration of the musculature of the diaphragm. There were no signs of shrinkage of the lungs or pleura to any extent such as one finds developing after tuberculosis or pneumonia. Neither were there any signs of plugging of a bronchus as in tumors of the lung, increased intraabdominal pressure as found resulting from liver enlargement, nor subphrenic abscess, etc.

If the relaxation of the diaphragm is general, when it is pushed upward by the adjacent intestines, one speaks of a relaxation of the diaphragm. If, however, the intestines enter the thorax through a defect in the diaphragm, regardless whether enclosed in a sac or not, the condition is designated as a diaphragmatic hernia (true or false). Even though the distinction is anatomically clear, yet it may be extremely difficult to distinguish between these conditions in vivo.

Various methods for differential diagnosis of these two pathological conditions of the diaphragm have been suggested. It was thought, for instance, that pneumoperitoneum offered a sure method of differentiation, since the gas enters the thorax through the defect in the diaphragm when a hernia is present and not with relaxation. However, this method may fail because of adhesions at the hernial opening. Another differential method, though useful only in left-sided changes of this sort, consists in measuring the gaseous pressure in the stomach (Hildebrand and Hess). Lowering of this pressure on inspiration and elevation on expiration is peculiar to hernia, while with relaxation of the diaphragm, there is first a decrease, then an increase of pressure on inspiration as well as on expiration. It is also possible to distinguish between these two conditions by comparing the relation of the various organs when the breath is held or when the position of the patient is changed (Beltz).

In using the stomach tube to pump air into or out of the stomach the boundary between stomach and thorax is frequently emphasized in hernia, while in relaxation a regular arch is retained regardless whether the stomach is full of air or empty.

Finally Glässner pointed out a characteristic crossed arch which is supposed to be due to the step-like structure of the diaphragm.

In the case under consideration, pneumoperitoneum could not be done because the patient objected to this procedure. The method of Hildebrand and Hess, and also that of Beltz, was out of the question because of the right-sided lesion. However the crossed arch of Glässner was present, the arch line crossing at the inner and outer side of the dome of the diaphragm.

It was originally assumed, inasmuch as most cases of relaxation of the diaphragm occurred on the left, that the double crossed arch line at the outer and inner side was formed by the diaphragm on the one hand, and the stomach wall, on the other. However, Assmann has already pointed out in his Handbuch that there is no ground for this assumption since there is no empty space between the stomach and diaphragm. The present case in which the stomach wall cannot be taken into consideration because of the right-sided lesion, further bears out the contention of Assmann.

As to the etiology and cause of the condition in the present case, we know that in 1920 there was an elevation of the diaphragm but no paradoxical movement was present. The diaphragm at this time was markedly bulging but had not as yet been crippled. The exact time when this loss of function of the right leaf of the diaphragm occurred is naturally impossible to determine. It is also difficult to decide whether the primary cause was a slowly progressive injury to the phrenic nerve due to the tough adhesion at the inner angle of the diaphragm, or whether it was due to a fatty degeneration of the weakened musculature. However, when we consider the partial bulging of the left leaf of the diaphragm in which two crossing arched lines could also be discerned, in spite of the fact that the respiratory excursions were not markedly interfered with, we may assume that in this case the primary cause of the lesion was a muscular degeneration, inasmuch as no changes occurred on the left side which could be attributed to a lesion of the phrenic nerve.

It is also possible that in this case the musculature of the diaphragm was weak to begin with, since the rest of the muscles in this small man were weak and poorly developed. Added to this is the fact that for years the patient, who was the owner of a small restaurant, did most of the work himself. Now we know that with the structures under discussion, even in robust individuals, certain pathological changes may take place, just as varices and pedes plani occur elsewhere, depending finally upon any unusual demand made on the involved structure.

It is possible that here the many burdens, which may often have been too great for the strength of this poorly developed man, may have played an etiological rôle in the production of this lesion. Any definite proof is of course impossible in this case. The subjective symptoms appear to be those resulting from compression of the thoracic viscera as a result of abdominal pressure upon a relaxed leaf of the diaphragm.

SUMMARY

A case is reported of right-sided relaxation of the diaphragm, with partial left-sided debility.

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Publisher: Charles C. Thomas, 220 East Monroe St., Springfield, Ill.

Thirty-second Annual Meeting: Atlantic City, N. J., 1931.

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Sixteenth Annual Meeting: Philadelphia, 1931.

Committee on Arrangements: G. E. Pfahler, Chairman, 1321 Spruce St., Philadelphia, W. S. Newcomet, Philadelphia, H. K. Pancoast, Philadelphia, W. H. Schmidt, Philadelphia, W. L. Clark, Philadelphia.

EDITORIALS

THE ANNUAL MEETING

THE Thirty-first Annual Meeting of the American Roentgen Ray Society was held at West Baden Springs Hotel, West Baden, Indiana, Sept. 23 to 26, 1930. The committee of arrangements in choosing West Baden made a departure from the usual custom by selecting a place which had no hospitals affording clinical facilities. It was thought by the committee that the meeting in such a splendid resort hotel would afford the members an opportunity to escape from the city and at the same time there would be no outside activities to interfere with the attendance at the meetings, and in this they were not mistaken for perhaps never have the various scientific sessions been better attended.

The program arranged by the President-elect, Dr. A. B. Moore, was an excellent one. The range of the subjects discussed was wide and the contributions from the members and invited guests set a high standard. A mere recital of some of the titles of the papers read gives an indication of the extent to which the roentgen ray has been utilized as a diagnostic and therapeutic agent in medicine since its discovery: "Opaque Oil in Maxillary Sinus Disease;" Pneumoconiosis;" "Blood Changes in the Lymphomata and the Leukemias and their Bearing on Roentgen-Ray Therapy;" "The Value of Roentgen Examination in Pulmonary Tuberculosis;" "Tuberculous Atelectatic Cirrhosis of the Lungs; Its Roentgenologic Significance;" "Intravenous Urography." There were of course numerous others of high merit and of incalculable importance. All of the papers will in due course of time be published in the Journal.

Aside from the scientific program, arrangements were made for the entertainment of those in attendance. On Monday afternoon, the day before the opening of the meeting, the annual golf tournament was held over the West Baden Springs Hotel course. Twenty-four golfers played eighteen holes which resulted in ties not only in the low gross but in the low net scores. These ties were played off on Tuesday with the result that the championship cup was presented to Dr. W. F. Manges, while the handicap championship trophy went to Dr. W. W. Belden.

On Tuesday evening Dr. Otto Glasser gave an entertaining talk on the life of William Konrad Roentgen and his discovery of the x-rays, illustrating his talk with many photographs of Roentgen, his family, his friends, and added a humorous touch by showing current comments and cartoons which appeared in the daily press at the time of the discovery. On this same evening, Dr. E. H. Skinner gave a talk on "American Roentgenology, Early Journals and Books" which added a delightful chapter to our rapidly accumulating historical data, and it is of tremendous importance to the Society and to roentgenologists in general that this material is being gathered together at this time when there are still living many men who participated in the early work with the roentgen ray. Dr. Skinner called particular attention to the fact that many of the early publications in this country dealing with the roentgen ray are difficult to obtain and those who have an interest in collecting books relative to their specialty would do well to avail themselves of every opportunity to acquire these rare books.

The Society was fortunate this year in having as the Caldwell Lecturer Dr. W. D. Coolidge, who chose as his subject "The Development of Modern X-Ray Generating Apparatus." In this he discussed the

historical development of the hot cathode tube, illustrating his talk with designs of the various tubes which he employed in his experimental and practical work and with illustrations of those now in common use. Roentgenology owes a great debt of gratitude to Dr. Coolidge for his contributions not only in this field of scientific work but for his many helpful suggestions and criticisms.

Those in charge of arrangements for the meeting wish, through the Journal, to express their thanks to all who contributed to the success of the meeting, and their especial thanks are extended to the manager and the staff of the West Baden Springs Hotel for their many courtesies and kindnesses shown to members and their guests.

APPOINTMENT OF DR. MORISON AS PROFESSOR OF RADIOLOGY, UNIVERSITY OF LONDON

THE many friends and acquaintances of Dr. J. M. Woodburn Morison will be interested in the following announcement appearing in the *British Journal of Radiology*, September, 1930, p. 390:

"Dr. J. M. Woodburn Morison, lecturer in radiology in the University of Edinburgh and radiologist to the Royal Infirmary of Edinburgh, has been appointed professor of radiology in the University of London, and Director of the radiological department of the Cancer Hospital, Fulham, in succession to the late Dr. Robert Knox. This is the first Chair of Radiology to be established in this country. The duties include the practice of X-ray and radium therapy at the Cancer Hospital, and the instruction of students in these subjects. Dr. Woodburn Morison, who is a native of Ayrshire, graduated at Glasgow University in 1896, and became assistant radiologist to the Royal Infirmary of Manchester, and consulting radiologist to the Ancoats Hospital, Manchester. He holds the Diploma in Radiology of the University of Cambridge, and has written much upon various aspects of the subject. He has been prominently connected with the Institute since its foundation, and is President of the Electrotherapeutics Section of the Royal Society of Medicine. He is a member of the Radium Commission and the Radium Trust. The Cancer Hospital, which is erecting a new radiological department, is to be congratulated, on its new appointment and bringing Dr. Morison to London."

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan St., Toledo, Ohio.
Thirty-second Annual Meeting: Atlantic City, N. J., 1931.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual Meeting: Philadelphia, 1931.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. G. W. Grier, Jenkins Arcade, Pittsburgh, Pa.
Annual meeting: Philadelphia, 1931.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. I. S. Trostler, 812 Marshall Field Annex, Chicago, Ill.
Sixteenth annual session: Los Angeles, Calif., Dec. 1–5, 1930.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY
Secretary, Dr. Orville N. Meland, 1407 S. Hope St., Los Angeles.
Meets on the third Wednesday of each month at the California Hospital.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. George M. Landau, 660 Groveland Park.
Meeting second Thursday of each month October to May inclusive at Virginia Hotel.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.
Meetings are held at 6 o'clock at the University Club on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. O. J. Shore, Fisher Building.
Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.
Meets first Friday in October, December, February and April.
Place of meeting designated by the president.

MINNESOTA RADIOLOGICAL SOCIETY
Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.
Next meeting, Minneapolis, Minn., Oct. 25, 1930.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. J. Bennett Edwards, Englewood Hospital, Englewood, N. J.
Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Karl Kornblum, 3400 Spruce St.
Meeting first Thursday of each month from October to May inclusive, at 8:15 P.M., in Thomson Hall, College of Physicians, 19 S. 22d St.

* Secretaries of societies not here listed are requested to send the necessary information to the Editor.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. Camp C. Thomas, 476 Lake Ave.
Meets monthly on the first Friday evening at 7:45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Missouri Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

UNIVERSITY OF MIGHIGAN ROENTGEN RAY SOCIETY
Secretary, Dr. D. M. Clark, University Hospital, Ann Arbor, Mich.
Meets every Wednesday evening from September to July, at 7:30 o'clock in the amphitheatre of the University Hospital.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.
Next meeting, Norfolk, Va., 1 P.M., Wednesday, Oct. 22, 1930.

Cuba

SOCIEDAD CUBANA DE RADIOLOGIA Y FISIOTERAPIA
Secretary, Dr. Francisco Padron, Enrique Villuendas 64, Havana, Cuba. Meets monthly in Havana.

British Empire

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christ-church.
Meets annually.

Continental Europe

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWELZERISCHE RÖNTGEN-GESELLSCHAFT)
Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

SOCIÉTÉ FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SÜD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖENTGENGESELLSCHAFT
Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Turin, Turin.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Nicolae Busila, 44 Elizabeta Blvd., Bucarest.
Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw. Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. O. Wissing, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

THE SCIENTIFIC EXHIBIT

The Scientific Exhibit at the West Baden meeting was as comprehensive and instructive as was the scientific program and those who spent the amount of time and energy necessary in the preparation of such valuable exhibits deserve the heartiest commendation.

Drs. T. O. Menees, J. D. Miller and L. E. Holly, Blodgett Memorial Hospital, Grand Rapids, Michigan had an exhibition on "Amniography." This is a somewhat new departure in roentgenography. The films were excellent, illustrating splendidly the points in question. While this is a new technique, in the hands of those who will apply it with caution, it will undoubtedly help to obviate some of the accidents in obstetrics, and will no doubt lead to further useful developments. A description of this method, with illustrations, will be found in this number of the Journal. This exhibit was selected by the committee on awards, composed of Dr. A. L. Gray, Dr. E. H. Skinner and Dr. W. B. Bowman, as being the "most original."

The Indiana University Hospitals, Indianapolis, sent an exhibit on "Bone Lesions Involving Bone Nuclei, Epiphyseal and Juxta-epiphyseal." This subject was illustrated with a comprehensive group of cases showing these various lesions in all parts of the body, and it is just such exhibits which focus attention on many closely allied conditions involving the bones whose roentgen and clinical differentiation is somewhat difficult.

The exhibit prepared by Drs. R. C. Beeler, L. A. Smith and J. N. Collins, Indianapolis, was on "Opaque Oils in Study of Antra." This consisted of films of the antra taken in the various positions, including a lateral study both before and after the injection of opaque oils. The importance was illustrated of studying certain selected cases of antral disease with opaque oils which bring into relief definitely suspected lesions not demonstrable on the films before the injection. It also brought out a valuable point in technique, namely,

the importance of taking the films at such an angle as to avoid the obscuration of the inferior portions of the antra by the overlapping shadows of the teeth. This exhibit was quite inclusive showing many pathological conditions, and also some cases with hypertrophy of the mucosa following the injection of the opaque oils.

Dr. B. R. Kirklin's exhibit from the Mayo Clinic covered three subjects—"Cholecystography;" "Urography;" "Gastrointestinal Lesions." The exhibit on oral cholecystography was most instructive, showing the absolute necessity of almost perfect technique in the demonstration of minute stone shadows and small polypi in the gall-bladder. Dr. Kirklin is to be congratulated on this comprehensive exhibit, which contained a world of information, and those who were privileged to make a detailed study of the films undoubtedly found it of great interest. In addition to the roentgenograms showing the various types of gall-bladders and stone shadows, the technique of administration of the dye was given, and there were photographs illustrating the position of the patient.

The exhibit on urography consisted of films taken after the intravenous administration of uroselectan. There were shown many pathological conditions of the urinary tract, together with the normal; the films were excellent, and the absence of gas in the intestinal tract was worthy of note.

The exhibit on gastrointestinal lesions consisted in films showing lesions of the colon among which were carcinomata and polyposis, multiple strictures of the sigmoid, as well as many showing ulcerative colitis.

The exhibit of Dr. Russell S. Rowland, from the Children's Clinic, assisted by Harper Hospital, Detroit, Michigan, was entitled "Anomalies of Lipoid Metabolism." These and the allied conditions—Gaucher's disease, Schüller-Christian's disease, and Niemann-Pick's disease—were illustrated with many films, photomicrographs, and photographs of the patients having these lesions, together with charts showing the clinical features in each individual group of cases and photographs of the pathological specimens. The great fund of information contained in Dr. Rowland's exhibit and its extreme importance in the differentiation of many obscure bone lesions were recognized by the committee which designated this as the "most educational."

Dr. R. S. Bromer, Children's Hospital, Philadelphia, had a comprehensive group of films on "Rickets." These showed various stages of the rachitic lesions, together with chest films illustrating the effect of rickets on the thoracic walls, as well as the intrapulmonary lesions often seen in rachitic conditions.

The exhibit of Drs. G. E. Pfahler and Jacob Vastine, Philadelphia, was on "Radium in Treatment of Cancer of the Mouth." This was illustrated with charts, photographs and roentgenograms of the patients showing the method of application together with the amount of radium used, as well as the filter, the distance and the time. In addition, there was a group of plaster models of the face showing the wax molds in position and the padding used for the radium packs. These plaster models illustrated in detail the special plan of treatment outlined for each case.

Dr. Otto Glasser of the Cleveland Clinic Foundation had a most interesting exhibit on "W. C. Roentgen and the Early History of the X-Ray." This contained many photographs of Roentgen, his family, his friends and his birthplace. There were also shown the earliest publications on Roentgen's discovery of the x-ray, together with some of the earliest x-ray tubes. Also of interest were the current comments and cartoons on the discovery. This material is being assembled and is to be published shortly by Dr. Glasser, and every roentgenologist should avail himself of the opportunity to acquire this life of Roentgen as soon as it comes from the press. This exhibit was considered by the committee to have "most profound merit."

Drs. Martin and Martin, Baylor Medical School, Dallas, Texas, had an exhibit on

"Cancer of the Mouth Treated by the English Method." This method was illustrated with crayon drawings showing the application and embedding of the radon needles and also photographs of the patients before and after treatment. In this technique the radon needles are embedded and sewed in and remain in place for a given number of days.

Of unusual interest was the exhibit of Dr. V. W. Archer, University, Virginia, on "Roentgen Diagnosis of Intestinal Ascariasis." Films were shown demonstrating intestinal ascariasis after the administration of barium. Dr. Archer is to be congratulated on the excellence of his films and the value of this study. The committee recognized Dr. Archer's contribution to roentgenology by judging it to have "most excellent merit."

Although to the great regret of those in attendance Dr. Hickey was not able to be present, he showed his continued interest in the Society by sending an exhibit on "Pulmonary Metastatic Neoplasms." The various types of carcinoma metastases to the lungs were shown, with many films pointing out the possibility of confusion with other lesions of the lungs.

"Encephalo-Ventriculograms in Fixed Lesions in Children" was the title of the exhibit of Dr. E. C. Vogt, Children's Hospital, Boston. This was a very beautiful collection of encephalo-ventriculograms demonstrating the various types of fixed lesions of the brain in children, including birth injuries, porencephaly, post-encephalitic changes and the ravages caused by pertussis. In addition he exhibited films of several cases showing the effects of lead poisoning, in which condition the diagnosis can be made by roentgen studies of the epiphyseal areas. An article dealing with this subject is soon to be published in the Journal.

The exhibit of Dr. S. A. Robins, Beth Israel Hospital, Boston, was called "Uterotubography." This was a very complete exhibit of uterotubograms showing a few normal and many pathological conditions of the uterus and tubes as outlined by lipiodol. Dr. Robins has developed his own technique and instruments, a full description of which has been published in this Journal. Some of the films showed multiple fibroliomyoma, and there were many films illustrating hyperplastic endometritis and some showing the change in size of the uterus during pregnancy and after parturition.

Dr. M. C. Sosman, Peter Bent Brigham Hospital, had an exhibit on "Diseases and Tumors of the Skull and Brain." This was a series of films from the clinic of Dr. Harvey Cushing, including all the various forms of tumors and diseases involving the cranial vault as well as the brain. This demonstration was in the nature of an atlas, all the various diseases being grouped together and different phases or locations of the same lesions being comparable by serial or contrasting films. It is to be hoped that no one failed to avail himself of the opportunity to examine this exhibit as perhaps from no other clinic in the world could such a group of cases be gathered. The Society is much indebted to Dr. Sosman and Dr. Cushing for this exhibit.

Dr. Robert B. Taft, Charleston, S. C., exhibited the instrument which he devised, namely, an "Automatic Polarizer for Synchronous Rectifier." A complete description of this instrument appears in the September number of the Journal. This accomplishment of Dr. Taft's was noted by the committee as being of "extreme scientific importance."

The exhibit of Drs. Pancoast, Pendergrass and Kornblum, Department of Radiology, Hospital of the University of Pennsylvania, was grouped under three headings—"Friedländer's Pneumonia;" "Pneumoconiosis;" "Intravenous Urography." That on Friedländer's pneumonia illustrated roentgenographically four stages of the disease which may be recognized: first, an initial or bronchopneumonic stage, usually of short duration; second, the pseudolobar stage in which the consolidated areas of the lung appear to have a

lobar distribution; third, the stage of multiple abscess or cavity formation. This presents a most characteristic roentgen appearance. It is in this stage that death usually occurs. The fourth is a healing stage or stage of fibrosis. This fibrosis may be permanent and is often characterized by numerous thin-walled cavities. It was pointed out that the clinical diagnosis is dependent upon finding the Friedländer bacillus by blood culture or in the sputum where it must be the predominant organism, present in large numbers and should be found on repeated examination.

The exhibit on pneumoconiosis was a most instructive one; it included films illustrating the earliest possible demonstration of this condition to its most advanced stages and also its frequent association with tuberculosis.

The films on intravenous urography showed the value of this new procedure.

This exhibit was selected by the Committee as being the "best of all."

The Society owes much to those who participated in the scientific exhibit. As can be seen, it included a wide field of roentgen studies and those who took the opportunity to examine the various exhibits must have benefited considerably. It is to be hoped that at the following meetings the committee of arrangements will allow a certain hour in the day during which the exhibitors may be present to explain in detail the various phases of their exhibits. While the exhibits were all splendidly marked and the lesions indicated, a great deal of additional information can be obtained from a personal demonstration.

The exhibits were assembled in uniform viewing boxes which gave a very attractive appearance and added considerably to their effectiveness. The exhibit frames are of the collapsible type, are quite compact and can be easily stored and transported and are to be the permanent property of the Society.

THE COMMERCIAL EXHIBIT

The Commercial Exhibit at the West Baden meeting was participated in by nearly all of the representative manufacturers of apparatus and various roentgenologic accessories. The exhibit was held in the large atrium of the West Baden Springs Hotel, which space allowed an arrangement and display of the apparatus to the best advantage. The Society is always appreciative of the trouble taken by the manufacturers in bringing together the various types of equipment which allows a survey of the latest advances along all lines with a minimum of time and effort. The following manufacturers were represented: Geo. W. Brady Co., Davies, Rose and Co., Eastman Kodak Co., General Electric X-Ray Co., Horlick's Malted Milk Corp., Kelley-Koett Mfg. Co., National Aniline and Chemical Co., Patterson Screen Co., Picker X-Ray Corp., Radon Co., Charles C. Thomas, Victoreen Instrument Co., Wappler Electric Co., an Westinghouse X-Ray Co.

RECEPTION TO DR. GRANGER

The Board of Administrators of Charity Hospital of Louisiana, at New Orleans, tendered a reception to Dr. Amedee Granger, at the Hospital on Sunday, October 5, 1930, upon the occasion of his twenty-fifth anniversary of continuous service as Chief of the Department of Radiology.

A CONVENIENT METHOD FOR MAKING RADIUM AND RADON SURFACE APPLICATORS, PLAQUES AND PACKS

By IRA I. KAPLAN, M.D.
Director, Division of Cancer, Department of Hospitals; Attending Radiation Therapist, Bellevue Hospital
NEW YORK CITY

THE devices used in applying radium to lesions in various parts of the body are too numerous to mention. Very few, however, of the earlier contrivances have lasted any length of time owing to the fact that they were either cumbersome, brittle, inconveniently made, or else required special processes in their manufacture or manipulation.

In the early attempts to use radium for the treatment of various lesions, little consideration was given to those physical properties of radium which we know today play an important part in governing the biological action of radium on body tissues.

Such important factors as the initial amount of radium used; the type of container; the character of the material through which the rays pass; the distance of the radiant source from the skin; the time of application, and the position in which it is attached—all these play an important part in the biological action of the radiation.

Following the first enthusiastic use of radium with subsequent unfortunate sequelae, more attention was paid to obtaining a better knowledge of the preparation of radium applicators.

Radium gives off during the process of its disintegration an emanation gas, or radon, which, while as potent as the element itself, is short-lived—its half life period being 3.85 days.

For surface applicators for various skin lesions it was the practice to use several types of enameled plaques, these being metal applicators with one surface coated with a radium impregnated enamel baked on. With radon this was quite impossible, but a suitable surface applicator equally as good as these enameled plaques can be made with the radon wax and emanation tubes.

For applying large doses of radiant energy over extensively involved tissue, heavy packs are required. Of course, when large quantities of radium element are at hand this is easily accomplished, but for the ordinary clinic the cost of this method is quite prohibitive, and as an equally effective substitute radon packs may be used.

Inasmuch as the body surfaces differ in each individual patient, special ingenuity is required in order to apply radiant energy to the lesion to be treated. To make these various applicators, plaques or packs, several substances have been suggested and complicated devices designed. The requisite material has to be easily and economically made, readily procurable, easily molded to fit various surfaces, capable of retaining its shape at body temperature, be light in weight, free from such substances as would cause secondary radiation, and able to have radon tubes readily attached to it. Also it has to be so constituted that various thicknesses can be easily built up from the surface with a like material.

In 1921, these requirements were successfully met through the manufacture of a specially prepared wax or "Pate Colombia," the formula for which was devised at the Curie Institute in Paris. This material is composed of beeswax, paraffin, and finely ground sawdust—the last being added to give it strength. This wax is made in sheets of various thicknesses and of two layers, one surface containing the sawdust and the other the combined wax. The darker—sawdust surface—is the one placed nearest the body tissue. On account of the difficulties encountered in importing this wax, with the consequent extra cost, we have obtained its manufacture* in America, thus making it readily and economically available to radium and radon users in this country.

This wax can be readily molded to meet the requirements for making surface

* By the Radon Co., Inc., New York City.

plaques, applicators or packs. To use it, the plate of wax is placed in water at 50–52°C. and allowed to become pliable. The amount required for making a particular applicator is cut off the plate and molded over the lesion—the sawdust impregnated surface next to the skin. Care is used to mold this wax evenly over the lesion in order not to alter its uniform thickness. After the mold is shaped it is placed in cold water and slightly fixed; then it is applied again before hardening, for final adjustment to the contours of the patient. Necessary holes for eyes, nose or lips can be cut through the wax with a warm knife blade before the mold is entirely hardened. In order to hold it in place it is tied with tapes through holes which are pushed through the borders of the mold by means of a heated awl. The radium or radon tubes in their proper filters are then attached to the mold by warming them slightly and dropping them in place on the wax surface, or by melting grooves in the wax and dropping the tubes therein and allowing the melted wax to cool over.

If additional protection of adjacent structures against the radiant energy is required, lead barriers may readily be attached to the wax. The molds may be removed and cleansed daily with soap and water and replaced without losing their form or shape.

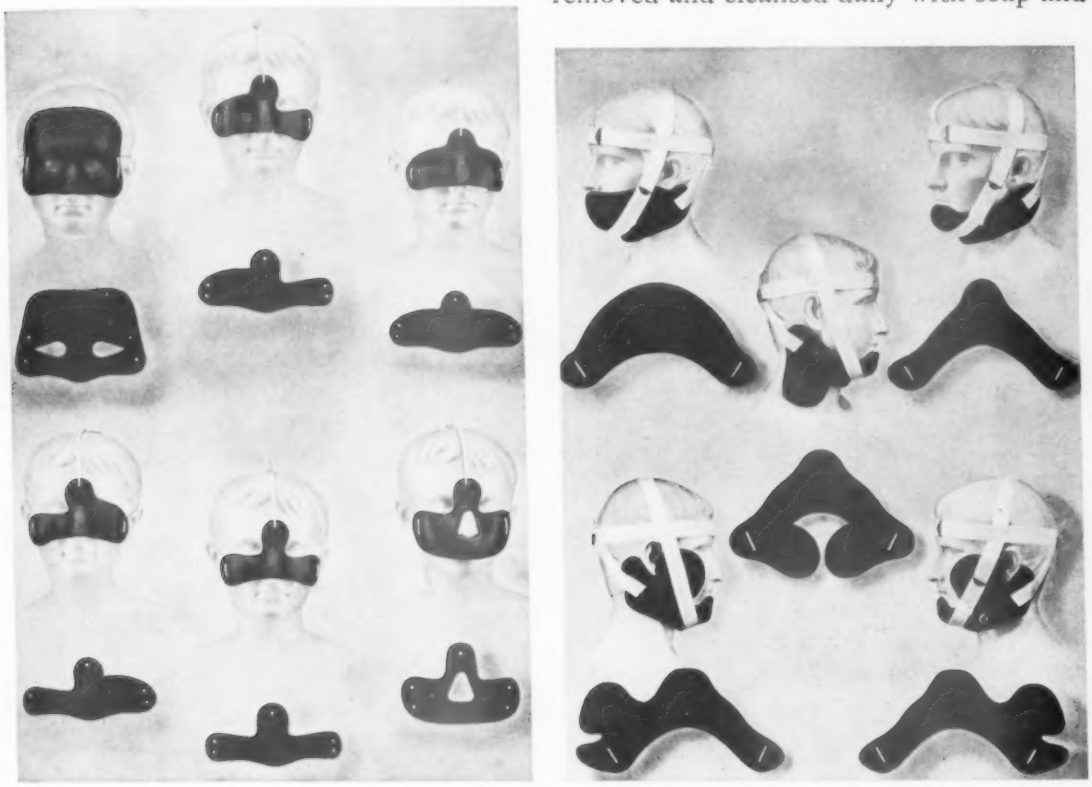

Fig. 1. Showing the various types of masks which can be made with radon wax (Bruneau & Co., Paris)

To make packs on which large quantities of radium or radon may be used, and where it is necessary to increase the distance from the surface to the radiant energy source, several layers of wax are built up to the required distance by melting one plate to the other.

The illustrations in Figure 1 will serve to show the various forms and shapes and the modes of application of several types of molds made from this wax.

CONCLUSION

A convenient means of making radium and radon surface applicators calls for a special material. Radon wax is an easily procured and readily molded substance, and can without difficulty be formed into such devices as the needs of the case require.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE EFFECT OF ROENTGEN IRRADIATION ON THE INTERRELATION BETWEEN MALIGNANT TUMORS AND THEIR HOSTS. (*Acta radiol., Suppl. VIII.*) By Carl Krebs. Paper. Price, Sw. cr. 8. Pp. 133, with illustrations. Stockholm: P. A. Norstedt & Soner, 1929.

This monograph is an experimental attempt to answer the questions: (1) How large a dose of roentgen rays is needed in order to produce a lethal effect on the cancer cell? (2) Is it possible to demonstrate any effect on cancer cells from doses that do not kill the latter? (3) Is it possible, by local roentgen irradiation, either to increase or to lower the resistance of an organism to a cancer tissue implanted either intracutaneously or subcutaneously in the exposed area.

A spontaneous carcinoma of the mammary gland which arose in the author's stock of mice was used for transplantation. This carcinoma corresponds to the simple adenocarcinoma as described by Apolant. Transplanted by careful aseptic methods this tumor gave an average of 50 per cent takes with 7 per cent metastases in the lungs.

A sarcoma which arose in a tar-painted mouse was also used for transplanting. This tumor showed a tendency to grow through the skin and muscle and frequently ulcerated. When implanted subcutaneously it gave 20 per cent metastases and when implanted intracutaneously metastases occurred as high as 60 per cent. Transplantation takes with this tumor averaged about 95 per cent.

These tumors were transplanted into mice. The author does not state the pedigree of the 835 animals used except that in so far as possible animals of the same weight and sex and coming from the same lot were used as experimental and control individuals.

The tumor tissues were exposed to roentgen doses of 3, 6, 9, 12, 15, 18, and 21 Sabouraud and Noiré units *in situ* and *in vitro*, using a 2 mm. Al filter and a skin focus distance of 23 cm. It was found that 3 Sabouraud-Noiré units required 3½ minutes' exposure and corresponded to about 1 H. E. D.

In studying the effects of these dosages on the transplanted tumors and on the hosts, only macroscopic measurements were used: (1) proportion of takes; (2) duration of animal's life after transplantation; (3) period of latency, and (4) rate of growth.

The author discusses the results with a rather full review of the literature. Illustrations and tables of findings are given to emphasize the text descriptions. However, no attempt was made to apply statistical criteria of significance in stating the results.

The lethal dose for the two tumors, both *in situ* and *in vitro*, was found to be 21 Sabouraud-Noiré units.

After doses of less than 9 S.-N. no appreciable difference in number of takes was noticed in the transplanted carcinoma, while the sarcoma gave a drop in percentage of takes after 3, 6 and 9 S.-N. When the dosage was increased to 12, 15 and 18 S.-N. the percentage of takes in the carcinoma fell to 23.8 while the takes in the sarcoma fell to 29.2 per cent.

Animals with the carcinoma transplants which were irradiated *in situ* showed an increase in average duration of life from 61 days after 3 S.-N. to 146 days after 15 S.-N. An observation which the author expresses inability to explain is that after 18 S.-N. there was a marked fall to 77 days average duration of life.

When irradiated *in vitro* the increase in duration of life was quite similar to irradiation *in situ*—61 days after 3 S.-N. to 143 days after 18 S.-N.

For the sarcoma the average duration of life for animals with the tumor irradiated *in situ* increased from 43 to 112 days; while those irradiated *in vitro* increased from 61 to 143 days after 18 S.-N.

From experiments in which the site was irradiated before transplantation, the animals showed an inhibitory effect toward growth of the carcinoma. A carcinoma implanted outside the site of irradiation was found to grow exactly as in a normal organism.

Roentgen irradiation of skin reduced the energy of growth of carcinoma transplants, reduced the number of takes and increased the average length of life of the animals. These

effects are most pronounced when the tumor is implanted intracutaneously.

In the case of the sarcoma there is a reduced growth energy but no reduction in the proportion of takes or increase in the average duration of life of the animals. The effect appears to be confined to tumor tissue growing in the cutis itself.

J. M. Murray

Experimental Studies on Roentgen Treatment of Malignant Tumors. (*Acta radiol., Suppl. IX.*) By Jens Juul. Paper. Price, Sw. cr. 8. Pp. 104, with illustrations, Stockholm: P. A. Norstedt & Soner, 1929.

The author gives detailed observations and discussion on experiments performed on white mice in which roentgen effects on two transplanted malignant tumors were studied from five different angles:

(1) Effects of local irradiation with different doses;
(2) Effects of general irradiation of the animals;
(3) Difference in effect between single massive doses and repeated smaller doses;
(4) Best effect on tumor, when skin effect is kept the same, between single massive doses and repeated smaller doses, and
(5) Whether the saturation method gives a stronger effect on the tumor than these other methods when the skin effects are kept alike.

Radiation methods and a comprehensive review of previous work precedes each section of the experiment, while the author's own discussion follows his personal presentation.

The animal material and transplanted tumors are the same as those used by Krebs in his investigations on the interrelation between malignant tumors and their hosts after roentgen irradiation. Since the animals could not stand a dose of more than 6 Sabouraud-Noiré units on the region of thorax and upper abdomen, the technique of transplantation was changed to the introduction by cannula of a small piece of tumor to an epilated area at the base of the tail. The carcinoma successfully grew in 70 per cent while the sarcoma grew in 90–100 per cent of the animals. Growth of both tumors was rapid. Metastases to the lungs were observed with both tumors, the sarcoma metastasizing much more frequently than the carcinoma.

The radiation technique employed a ray of hard quality, 5 mm. Al being used. In a field 10×10 cm., 1 H. E. D. for man was produced in 21 minutes. At 23 cm. focal distance 1 H. E. D. corresponded to 3.5 S.-N. Only macroscopic observations were recorded: (1) Tumor's rate of growth; (2) number of tumors that disappeared or percentage of takes, and (3) average of life in animals with persistent tumors.

Charts showing the details of tumor growths are given for each animal, the number of individuals being larger than in most experiments of this type. Since the animals were from a stock in which pedigree or exact age is not given, the significance in some instances is difficult to evaluate.

In the final section of this monograph the author gives a brief comparison of the experimental results and clinical experiences and emphasizes the following conclusions:

(1) The dose should be as large as practicable without involving any serious injury to important adjacent organs or tissues.

(2) Irradiation of large parts of the body with large doses of roentgen rays should be avoided.

(3) Distribution of a dose over a longer time gives less effect than the same dose distributed over a short time.

(4) The fractional or protracted irradiation should be preferred, however, as such treatment allows of a larger total dose and therefore gives a better therapeutic effect than can be obtained with the massive dose method.

(5) The saturation method is preferable to the simple fractional method.

J. M. Murray

Die Radiumbehandlung in der Augenheilkunde. Von Dr. Leo Kumer, o.ö. Univ.-Prof., Innsbruck, Gew. ass. d. Univ.-Klinik f. Dermat. u. Syphil., in Wien (Vorstand Prof. Dr. L. Arzt), and Dr. L. Sallmann, Assistent der II. Universitäts-Augenklinik in Wien (Vorstand Prof. Dr. K. Lindner). Paper. Price, 14.40 Rm. Pp. 198, with 65 illustrations. Wien: Julius Springer, 1929.

This is a presentation of the use of radium in ophthalmology with special attention to clinical aspects. Principles of physics are discussed briefly, and technical problems and the action of radiation on the delicate ocular structures are given due consideration. The major part of the volume is devoted to pathological

conditions in and about the eye, the advisability of radium therapy, the dosage and the probable results as forecast by experience of the authors and others.

The text is interspersed freely with citations from the works of numerous authors and there is appended a list of several hundred references which seem to rather completely review the literature on the subject and is in itself a worthy addition to one's library.

Although the volume is concerned primarily with the use of radium, each case is considered on its merits, and if the experience indicates, roentgen therapy or a combined technique is recommended. The attitude of the authors is sufficiently conservative and their reasoning seems sound. Radiologists, ophthalmologists and dermatologists alike should find in the volume much of interest and value.

E. W. Hall

Medical and Surgical Year-Book of the Physicians Hospital of Plattsburgh. Comprising Wednesday Afternoon Invitation Lectures, Papers of the Cardiac Round Table, the First Beaumont Lecture, and Collected Papers by the Staff. Cloth. Price, $3.50. Pp. 322, with 72 illustrations. Plattsburgh, N. Y.: The William H. Miner Foundation, 1930.

This book represents a collection of lectures and papers by guest lecturers and members of the Hospital Visiting Staff of the Physicians Hospital of Plattsburgh, N. Y., and published under the general direction of the Instruction Committee, composed of Harris A. Houghton, M.D., Chairman, Cassius D. Silver, M.D., Chief of Staff, and Irving S. Haynes, M.D. The activity which formed the basis of the collection of these papers was a summer course for the study of cardiorenal disease and arterial hypertension for undergraduate medical students about to enter the senior year in their several medical colleges. This course was intended as a supplement to the work of the medical school, and to offer increased facilities for physical examination and the study of patients. As a more formal part of the course, lectures and round table discussions were arranged, and the recording of these largely makes up the book.

The first section of the book is given over to seven invitation lectures by as many lecturers. Three of these lectures deal particularly with heart disease, two with pneumonia one with congenital syphilis, and one with the enterogenic factors in cardionephritic states.

The second section of the book is devoted to the "Cardiac Round Table" exercises, under fourteen titles by as many authors. The papers presented here show a wide interest in the study and management of heart disease.

The closing feature of the Cardiac Round Table was the 'First Beaumont Lecture," and in addition to the physicians and students present, was attended largely by people of Plattsburgh who are interested in local history. This lectureship was established in honor of Dr. William Beaumont, "America's Pioneer Physiologist," who participated as a surgeon's mate in the land engagement of the Battle of Plattsburgh, and shortly after began the practice of medicine and surgery in this city. Some of his famous experiments on Alexis St. Martin were performed while he lived in Plattsburgh.

The Beaumont lecturer of 1929 was Dr. Walter R. Steiner of Hartford, Conn., who delivered an address on "Dr. William Beaumont, An Appreciation." At the close, a suitably inscribed bronze tablet (frontispiece), which had been placed on the west facade of the First National Bank building, the site where Dr. Beaumont began the private practice of medicine and surgery, was unveiled.

The last part of the book is occupied by a collection of fourteen papers on widely different subjects by various members of the Hospital Visiting Staff.

This work would indicate a high ideal and a great conscientious effort by a very admirable and creditable plan of extra-curricular teaching. The book itself is a splendid example of this type of publication.

Charles L. Brown

THE CHEST. (*Annals of Roentgenology. Vol. XI.* Edited by James T. Case, M.D.) By L. R. Sante, M.D., F.A.C.P. Cloth. Price, $20.00. Pp. 561, with 246 illustrations. New York: Paul B. Hoeber, Inc., 1930.

DISEASES OF THE SKIN. A Text-Book for Practitioners and Students. By George Clinton Andrews, A.B., M.D., Associate Professor of Dermatology, College of Physicians and Surgeons, Columbia University; Consulting Dermatologist and Syphilologist to Tarrytown Hospital; to St. John's Hospital, Yonkers; to Grassland's Hospital, and to the Broad Street Hospital, New York City. Cloth. Price, $12.00. Pp. 1091, with 988 illustrations. Philadelphia and London: W. B. Saunders Co., 1930.

INTESTINAL TUBERCULOSIS: ITS IMPORTANCE, DIAGNOSIS AND TREATMENT. A Study of the Secondary Ulcerative Type. By Lawrason Brown, M.D., Consultant to the Trudeau Sanatorium, and Homer L. Sampson, Roentgenographer of the Trudeau Sanatorium, Saranac Lake, New York. Second edition, thoroughly revised. Cloth. Price, $4.75. Pp. 376, with 122 engravings and 2 colored plates. Philadelphia: Lea and Febiger, 1930.

SELECTED READINGS IN THE HISTORY OF PHYSIOLOGY. Edited by John Farquhar Fulton, M.D., Formerly Fellow of Magdalen College, Oxford; Sterling Professor of Physiology, Yale University. Cloth. Price, $5.00. Pp. 317, with 60 illustrations. Springfield, Illinois: Charles C. Thomas, 1930.

NORMALE ANATOMIE DES KOPFES IM RÖNTGENBILD. I. TEIL. (*Radiologische Praktika, Band XII.*) Von Karl Goldhamer, Leiter des Röntgenlaboratoriums an der I. Anatomischen Lehrkanzel (Prof. Tandler) in Wien. Cloth. Price, M. 120. With 30 photographic plates, 30 illustrative schemas and 15 projection diagrams. Leipzig: Georg Thieme, 1930.

IODIZED OILS AS AN AID TO THE DIAGNOSIS OF LESIONS OF THE SPINAL CORD AND A CONTRIBUTION TO THE KNOWLEDGE OF ADHESIVE CIRCUMSCRIBED MENINGITIS. (*Acta radiol., Suppl. VII.*) By Martin Odin and Gosta Runstrom, in cooperation with Adolf Lindblom. Paper. Price, Sw. cr. 15. Pp. 86, with 4 figures in the text and 38 figures on 6 plates. Stockholm: P. A. Norstedt & Soner, 1922.

THE BEGINNINGS: EGYPT AND ASSYRIA. By Warren R. Dawson, F.R.S.E., Fellow of the Royal Society of Medicine, of the Society of Antiquaries of Scotland, and of the Royal Anthropological Institute of Great Britain and Ireland. Cloth. Price, $1.50. Pp. 86. New York: Paul B. Hoeber, Inc., 1930.

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

Head

Chobot, Robert. The incidence of sinusitis in asthmatic children. *Am. J. Dis. Child.*, Feb., 1930, *39*, 257–264.

Chobot believes that the incidence of sinus infection in asthmatic as well as in normal children is much higher than has hitherto been believed. In his series of 100 asthmatic children, 14 per cent had their first attack in the first year of life and 19 per cent in the second year, which figures compare closely with those of other observers. Fifteen per cent had negative skin reactions. The incidence of the age of onset of this group parallels that in hypersensitive patients. Fifteen per cent of the sensitive patients had their first attack in the first year and 23 per cent in the second year. Forty-one per cent of all patients, both sensitive and nonsensitive, had sinus infections, as shown by roentgen examination. He believes that treatment should be conservative, but puncture and irrigation should be carried out when conservative measures fail. The anatomy of the nasal passages, while making puncture difficult, at the same time enables many of the sinuses to drain spontaneously. Conservative measures such as shrinking down the mucous membrane, and simple nasal irrigation often suffice.—*R. S. Bromer.*

Jeanneney, G., and Wangermez, Ch. Le role de la structure osseuse dans les fractures du crane (étude radiologique). (The rôle of the osseous structures in fractures of the cranium; a roentgen study.) *Presse méd.*, Feb. 26, 1930, *38*, 284–285.

The most common fractures of the skull (fronto-sphenoidal, spheno-petrous, petro-occipital, as well as fractures of the pyramid) were studied by roentgenograms of dried specimens and it was found that the fracture always follows the line of least resistance.—*T. Leucutia.*

Neck and Chest

Malnekoff, B. J. Acute mediastinal abscess. *Am. J. Dis. Child.*, March, 1930, *39*, 591–594.

Malnekoff reports a case of acute mediastinal abscess occurring in a child of twenty-one months who first developed an infection of the upper respiratory tract followed by an attack of measles. Three weeks after the onset roentgenograms showed a dense shadow lying well inside of the anterior mediastinum and outside the right lung. The child was hoarse, had a brassy cough, and complained of difficulty in swallowing. Repeated aspirations close to the sternum were made and the case went on to an uneventful recovery. Roentgenograms made eighteen months after the onset of the illness showed normal lungs and mediastinal shadows. Illustrations of the roentgenograms of the case show the appearance of the abscess shadow at the time the diagnosis was made, after aspiration and ultraviolet therapy, and eighteen months after the onset of the disease.—*R. S. Bromer.*

Airale. Diverticolo esofageo di rapido svillupo. (Diverticulum of the esophagus which developed rapidly.) *Arch. di radiol.*, Jan.–Feb., 1930, *6*, 207.

The author presents a case of large diverticulum of the precardiac part of the esophagus which had developed rapidly, for at an examination made two months before there had been no signs of it. The patient's symptoms at first were stomach symptoms but those he has now are esophageal. Diverticula of the lower part of the esophagus are unusual and it is very seldom that there is any such information as in this case in regard to the time required for the development of a diverticulum to such a size. The roentgenogram showed the diverticulum sharply circumscribed, irregularly conical in form and almost totally filled with the contrast medium so that no empty space was left above it. As such a finding in diverticulum is rare it suggests the possibility that the esophagus may have perforated and a sac have formed from reaction of the surrounding connective tissue.—*Audrey G. Morgan.*

Bergmann, O. Sur une modification du procédé de mesure du diamètre de l'aorte ascendante. (On a modification of the pro-

cedure of measuring the diameter of the ascending aorta.) *Bull. et mém. Soc. de radiol. méd. de France*, Dec., 1929, *17*, 285–286.

The roentgen estimation of the diameter of the ascending aorta encounters considerable difficulties on account of inability to accurately delineate the two borders simultaneously. In 1926 Reich called attention to the fact that the two borders are best visible 0.5 to 1 cm. underneath the bifurcation of the trachea, the patient being in an oblique position (near 45°). In rechecking this procedure the author found that it has considerable practical value and therefore she advises that it be used routinely. In some instances the sternal shadow interferes with good visibility of one of the borders but by a slight increase in the angle of rotation this can be easily overcome.—*T. Leucutia.*

Huet, J. A., and Duval. A propos de l'examen radiologique de certains processus de pleurites apicales. (Concerning the roentgen examination of certain processes of apical pleuritis.) *Bull. et mém. Soc. de radiol. méd. de France*, Feb., 1930, *18*, 76–79.

Seven cases of apical pleuritis were observed in the course of 400 chest examinations.

The conclusion is reached that the roentgen diagnosis of apical pleuritis belongs to the rarest occurrences and that an accurate diagnosis can be made only in conjunction with certain clinical findings. Its detection is important for two reasons: (1) it leads to an early diagnosis of apical tuberculosis, and (2) it permits certain estimations with regard to the indication of an artificial pneumothorax.—*T. Leucutia.*

Barros, Enrique. La psittacose. (Psittacosis.) *Rev. sud-amér. de méd. et de chir.*, March, 1930, *1*, 225–235.

Eighty cases of psittacosis were observed at Cordova and it was found that many of these presented changes within the chest which could be classified as follows: (*a*) pneumonic forms; (*b*) forms with congestion of the bases; (*c*) corticopleuritis; (*d*) bronchopneumonias of prolonged duration, and (*e*) forms of hepatization. The roentgen examination is of considerable aid in these instances.

In a manner similar to the grip, pneumonia and bronchopneumonia were responsible for the rather large mortality in psittacosis.—*T. Leucutia.*

Patey, D. H. The effect of abdominal operations on the mechanism of respiration; with special reference to pulmonary embolism and massive collapse of the lungs. *Brit. J. Surg.*, Jan., 1930, *17*, 487–497.

Patey states that it is a well-established fact that operations on the abdomen are definitely more liable than surgical procedures in the other parts of the body, to be followed by two types of complication: (1) pulmonary embolism and thrombosis, and (2) collapse and inflammatory affections of the lung bases.

His statistics, as well as those of previous authors, show that pulmonary embolism and thrombosis follow operations upon all parts of the abdomen and are not more prone to occur in those involving the upper portion only. The occurrence of these complications certainly is much greater following abdominal operations than in extra-abdominal procedures. Collapse and inflammatory affections of the bases of the lungs also show a special tendency to follow operations. The latter seem to be dependent on interference in some way with the mechanism of respiration, either directly or indirectly. Thus pain because of the incision, may prevent the patient from taking a full breath. In observations Patey found there was a definite fall in vital capacity in patients having incisions in the abdominal wall. There is also a reduction in the amount of air expired with each normal respiration and he also concludes from roentgen studies, that the respiratory excursions of the diaphragm are diminished. Suggested means of combating the diaphragmatic inhibition are postoperative deep-breathing exercises, inhalations of CO_2 gas as a routine after operation, attempts to diminish pain by means such as the use of novocaine and other local anesthetics, the administration of morphine, etc. These have not proved entirely satisfactory and the problem is really unsolved.

In an investigation of the percentage of carbon dioxide in the alveolar air, Patey noted that the readings on the second day following operation were lower as compared with the preoperative readings. The reasons for this he believes are the following: (1) the abdominal muscles being interfered with in respiration, they are unable to express the air so completely from the lungs as in normal cases, and (2) the greater tendency of the injured musculature to tire. In regard to intraabdominal respiratory variations of pressure, he

found that in postoperative cases as a rule there were: (1) less regularity of the postoperative curve; (2) the undulations of quiet respiration are diminished, and the amplification on deep breathing is much lessened; (3) the secondary curve of late expiration, if present before operation, is either greatly diminished or disappears. If an abdominal incision disorganizes the intraabdominal pressure, venous stasis results. Thus abdominal massage that reproduces the normal abdominal pump mechanism should theoretically be of assistance in overcoming this stasis and facilitate venous return. Other helpful measures would be, combating postoperative distention of the abdomen, and firm support in splinting the injured abdominal musculature.

He concludes that any influence, that interference with respiration has, is of a predisposing nature only, and that other factors are necessary for the development of the above complications.—*R. S. Bromer.*

Barnes, Harry L., and Barnes, Lena R. P. The duration of fatal phthisis. *Am. Rev. Tuberc.*, Dec., 1929, *20*, 895–900.

A statistical report from the State Sanatorium, Wallum Lake, Rhode Island. Out of 8,425 cases admitted to the Sanatorium in the years 1905 to 1926 inclusive, 2,537 who died of phthisis afforded data sufficiently satisfactory to be available for this study.

The average duration of life for the 2,537 patients was 36.72 months. For the males in this group the average duration was 37.93 months, females, 34.81 months; white patients of which there were 2,424—37.81 months and 111 colored patients—19.59 months. Patients with hemoptysis lived longer than those without hemoptysis. Of 51 patients with a history of pleurisy with effusion, if the onset be dated from the onset of pleurisy, the average duration of life was 51 months, while if the duration was taken from the onset of continuous pulmonary symptoms the duration was but 37 months.

Various observers have recorded the duration of fatal phthisis from time to time and it is to be noted that the figures given correspond very closely to those offered in this present research.

The authors point out the difficulty in such a study especially as to the determination of the onset of tuberculosis. The insidiousness of the disease makes it difficult for the patient to state accurately the onset of symptoms. Other factors influencing the duration of life in pulmonary tuberculosis are the financial circumstances of the patients, and the selection of patients for institutional care as regards the stage of the disease when admitted.

Obviously such a study as this is of considerable importance from medical and economic standpoints.—*Karl Kornblum.*

Von Glahn, William G. Neoplasms of the lung. *Am. Rev. Tuberc.*, Jan., 1930, *21*, 57–69.

A discussion is given of neoplasms of the lung containing a brief reference to such rare tumors as congenital cysts, congenital adenomata and chondromata. More refined histological methods have shown that sarcomata, once regarded as fairly common, are in reality uncommon.

Carcinoma forms the largest group of pulmonary neoplasms. Reference is made to the work of various investigators who have attempted experimentally to produce tumors in the lungs of animals, hoping in this way to learn something as to the possible etiology of lung tumors. Some of the etiological factors considered in human pulmonary neoplasms are inhalations of radioactive dusts and dusts from tarred roads, inhalations of irritant gases, tobacco smoke and industrial dusts, overgrowth of epithelium following influenza and lung changes in chronic tuberculosis. Metaplasia of the bronchial epithelium in chronic bronchitis and bronchiectatic cavities is believed to favor the growth of a tumor.

Carcinoma of the lung occurs more frequently in males than in females, the ratio being about 3 to 1. The incidence is highest between the ages of fifty and seventy.

The usual sources from which tumors arise are the bronchial and alveolar epithelium and bronchial glands. A primary bronchus is the most frequent site of the origin. The right lung is slightly more often involved than the left. Metastases are often widespread.

The more usual types of pulmonary carcinomata are illustrated by case reports with autopsy findings. No roentgenograms are included. Examples are given of carcinoma arising from primary bronchi, in tuberculous foci, from alveolar epithelium and in a bronchiectatic cavity.

The paper is concluded with a discussion of the incidence of pulmonary carcinoma. Statistics from various hospitals both abroad and in this country are given. Some of these show an increase in incidence in recent years while others fail to show any change in the incidence. The author states that his study of the available statistics leaves him in doubt as to whether there has been an actual increase of lung carcinoma.—*Karl Kornblum.*

Abdomen

Segar, Louis H., and Stoeffler, Walter. Cardiospasm in the new-born infant. *Am. J. Dis. Child.*, Feb., 1930, *39*, 354–359.

With the exception of one previous report, the authors state that they have found no case reports of the occurrence of cardiospasm in infants. Two cases seen by them within a short time suggest that its occurrence may be less rare than is commonly supposed.

They report 2 cases of vomiting occurring in new-born infants. This occurred immediately after a few swallows of any fluid were taken, milk being unchanged in character. Dysphagia and discomfort were noted just before vomiting occurred. In the first case, one ounce of barium mixture was taken without regurgitation. After 2 or 3 swallows which went directly into the stomach, there was definite stasis in the esophagus which remained for an hour. At 18 hours the esophagus and the stomach were empty. In the second case, the roentgenogram made after the ingestion of the meal showed barium in the esophagus and the stomach, occupying the lower end of the former and tapering down to a fine point at the cardia. One hour later the barium still remained in the lower end of the esophagus.

The authors comment on the various theories of the cause of cardiospasm, and believe that the stenosis in their cases was apparently due to a temporary incoordination of the deglutitory cycle.—*R. S. Bromer.*

Rupp, Alice, and Schultz, Frederic W. Motility of the empty stomach in normal and in malnourished asthenic children. *Am. J. Dis. Child.*, Feb. 1930, *39*, 241–256.

Most investigators who have studied gastric motility in children have made use of the methods of gastric expressions and roentgen examination chiefly for the determination of the emptying time of the digesting stomach. The authors state that such studies are limited by the fact that the examinations are brief and are made only at certain intervals, so that it is impossible to obtain a continuous record of gastric activity.

As activity of the stomach is somewhat variable, they thought that a continuous examination over an extended period might yield valuable information with regard to the inherent power of the gastric musculature under certain conditions. Their paper deals with motility of the empty stomach in normal children, and in those who are of the asthenic body habitus and in a malnourished condition, being underweight for the age and height. Their study includes 5 normal and 14 asthenic children.

The method employed was that of Carlson: A deflated balloon was attached to one end of a rubber tube and was swallowed by the subject, the other end of the tube being connected with a manometer fitted with a lever, arranged in such a manner that a graphic record was obtained on smoked paper mounted on a moving drum. When the balloon was inflated at the beginning of an experiment, the pressure changes due to the contractions of the stomach were recorded. The advantage of this method lay in the fact that a continuous record of the activity over a long period of time could be obtained.

They conclude that gastric activity during hunger in children is intermediate in degree between that in the new-born infant and that in the adult. The activity of the empty stomach is decreased in malnourished asthenic children in comparison with the normal, and is still further decreased in those with certain gastrointestinal complaints. No explanation for this decrease in activity is offered as yet.—*R. S. Bromer.*

Ledoux-Lebard, Calderon, Garcia, and Jahiel. Sur un cas de sténose du grêle après gastro-entérostomie. (A case of stenosis of the small intestine following gastroenterostomy.) *Bull. et mém. Soc. de radiol. méd. de France*, Feb., 1930, *18*, 74–76.

A stenosis of the jejunum, localized to the efferent part of the gastroenterostomic stoma, is described in a man forty years of age. Soon after the gastroenterostomy the digestive disturbances recurred and a roentgen examination made several months later revealed a

peculiar image, first giving the impression of a biloculation and later (after the filling of the dilated ends above the stenosis) of a triloculation of the stomach.

Following operation, which consisted in a jejuno-jejunostomy, there was healing, lasting now for a period of over a year.—*T. Leucutia.*

Grado. Diverticoli del colon ed appendici epiploiche. (Diverticula of the colon and appendices epiploica.) *Arch. di radiol.*, Jan.-Feb., 1930, *6*, 228.

The author presents the case of a woman with a soft fluctuating swelling in the right iliac fossa accompanied by fever and pain which on roentgen examination was found to involve the right adnexa. The examination also showed many diverticula along the transverse colon which the author believes were insinuated into the appendices epiploicae. He describes the mechanism of their formation and concludes by saying that in addition to other factors in their production, they are caused by the arrangement of the muscle fibers of this tract of the intestine and the gaps in the peritoneum represented by the appendices epiploicae.—*Audrey G. Morgan.*

Santoro, Mario. Nuovo sintoma radiologico di Busi nella invaginazione ileo-ceco-colica. (Busi's roentgen sign in ileo-ceco-colic invagination.) *Arch. di radiol.*, Jan.-Feb., 1930, *6*, 207–224.

Three cases of ileo-ceco-colic invagination are described in which the author saw the roentgen sign described by Busi in 1926. It consists of a series of more or less complete rings caused by the contrast liquid infiltrating between the walls of the invaginated and invaginating parts of the intestine and accumulating in the haustra of the invaginating part. This sign is obtained by giving barium by mouth. It is always advisable to begin with the administration of barium by mouth and not give an opaque enema until afterward. The 3 cases were operated on and no changes found in the walls of the intestine, so apparently spastic contraction of the cecal sphincters is of great importance in causing this disease.—*Audrey G. Morgan.*

Gargiulo, Mario. Il quadro radiologico del colon destro nello svuotamento rapido dello stomaco. (The roentgen picture of the right colon in rapid emptying of the stomach.) *Arch. di radiol.*, Jan.-Feb., 1930, *6*, 183–206.

The author gives illustrative roentgenograms showing that the changed chemism of the stomach in rapid emptying causes slight lesions in the right colon which, while they do not increase to such an extent as to cause a true colitis, yet give a roentgen picture that is very much like that of ulcerous colitis.—*Audrey G. Morgan.*

Anderson, John H., and Marxer, O. A. Multiple polyposis of the colon. *Brit. J. Surg.*, Jan., 1930, *17*, 451–455.

The authors report 2 cases of ulcerative colitis with multiple polyposis of the colon. They state that the difficulty lies in the diagnosis of multiple polyposis and as the symptons are those of ulcerative colitis, the sigmoidoscope and the roentgen ray offer the only means of recognizing the condition short of opening the abdomen and the colon. Unless the roentgenologist is warned of the presence of colitis, the polyposis may be missed, owing to the rapid passage of the meal through the colon. Frequent examinations are necessary, and the general routine of the barium meal may require considerable modification. In some cases the barium enema was given fifteen minutes after a hypodermic of morphia gr. one-sixth, and atropine sulphate, gr. one-hundredth. The material was run in at low pressure (18 in.) with the foot of the couch raised and the patient prone.

In polyposis the filled bowel is studded with concave impressions on the otherwise smooth margin, and the mucosa in general presents a mottled or honeycomb appearance, probably due to only a thin coating of opaque material being present in parts, owing to the displacement by the polypi. If the bowel is too distended to show this mottling, pressure with a wooden spoon or airbag may produce it. Serial films showed some exaggeration of the lesser movements of the colon, but frequent incomplete mass movements were present with a slowing of the relaxation phase and absence of segmentation. The nodular filling defects at the margins of the filled bowel and the honeycomb appearance of the colon as a whole are the main features in excluding uncomplicated colitis.

Polypi of the colon are of two types, inflammatory and true tumors, the latter being more

frequently encountered. The authors feel that it is uncertain whether inflammatory polypi can be diagnosed roentgenographically due to the fact that inflammatory polypi are strips of mucous membrane which have become detached along almost their whole length, due to the undermining character of the ulceration.—*R. S. Bromer.*

Mirizzi, P. L. Diagnostic des tumeurs kystiques du pancréas. Importance des rayons X et de la reaction de Wohlgemuth. (Diagnosis of cystic tumors of the pancreas. Importance of roentgen rays and of the Wohlgemuth reaction.) *Rev. sud-amér. de méd. et de chir.*, March, 1930, *1*, 236–246.

Four cases of pancreatic cysts are briefly described and—in addition to the value of the Wohlgemuth reaction in urine—the importance of the roentgen findings is discussed.

One of the chief roentgen signs in pancreatic cysts is the deformity produced on the stomach. If the cyst involves the gastrocolic ligament the pressure is mainly on the greater curvature, often leading to obliteration with inversion of the lesser curvature, while if the cyst originates within the lesser omentum, the pressure is chiefly on the lesser curvature, leading to the so-called hour-glass appearance.—*T. Leucutia.*

Epifanio, G. La radiologia del peritoneo. Epiploitis and mesenteritis. (The roentgenology of the peritoneum. Epiploitis and mesenteritis.) *Arch. di radiol.*, Jan.-Feb., 1930, *6*, 227–228.

The author presented a hundred roentgenograms showing many clinical cases of epiploitis and perivisceritis. They occurred in various inflammatory and ulcerative conditions of the abdominal organs. They are brought about by the protective and plastic function of the peritoneum which is developed to the highest degree in the great omentum; when an inflammatory or ulcerative process or a simple circulatory disturbance effects one or more of the abdominal organs the peritoneum which surrounds them, the meso which suspends them and the omentum which unites them like a bridge, all take part in the inflammatory process, bringing about perivisceritis, mesenteritis and epiploitis, which after an acute phase tends to pass into a chronic condition with a tendency to acute exacerbations. These local fibroplastic chronic inflammations tend to perpetuate the disturbance in the organ in which it originated and complicate the clinical picture. The author shows that the roentgenology of the peritoneum is an important chapter in clinical roentgenology.—*Audrey G. Morgan.*

Vita, Giulio. Importanza del pneumoperitoneo nella diagnosi differenziale fra cistoma ovarico e peritonite tuberculare forma ascitica. (Importance of pneumoperitoneum in differential diagnosis between cystoma of the ovary and the ascitic form of tuberculous peritonitis.) *Arch. di radiol.*, Jan.-Feb., 1930, *6*, 224–226.

A case is described in a patient aged twenty, with no family or personal history of any importance, who for two years had noticed a progressive increase in the size of her abdomen. She did not have fever. Recently she had had serious heart and respiratory disturbances on account of the increased size of the abdomen. A noted clinician and an equally noted surgeon both made a diagnosis of tuberculous peritonitis but treatment for that condition did no good and the patient was sent to the author for roentgen examination. It showed the diaphragm displaced upward with reduced size of the lung fields. The stomach was displaced upward and emptied in normal time. There were no anatomical defects and no special pain. The small intestine was pushed upward and laterally. The cecum and ascending colon were pushed upward beneath the costal arch. There was evidently intra-abdominal tension that pushed the viscera upward. Such a displacement could not have been caused by free liquid. A diagnostic pneumoperitoneum with oxygen was practiced to clear up the diagnosis. Two liters of oxygen were injected into the abdominal cavity and a roentgenogram taken. It showed that the intra-abdominal pressure was caused by a mass that displaced the viscera upward. Operation confirmed the diagnosis and an enormous multilocular ovarian cystoma was removed that weighed about 5 kilograms.

Pneumoperitoneum is of great value in this differential diagnosis in which mistakes are often made.—*Audrey G. Morgan.*

Genitourinary System

Debenham, R. K. A case of anomalous kidney producing symptoms. *Brit. J. Surg.*, Jan., 1930, *17*, 557–560.

Debenham reports a case of anomalous kidney, quoting statistics of the frequency of the different forms of renal anomalies. His case produced symptoms at the age of thirty-three, and was associated with hydronephrosis. The diagnosis lay between carcinoma of the colon and a renal swelling, a pyelogram having been most useful in deciding the question. A roentgenogram of the urinary tract first made, was negative, the right kidney being normal in size. A barium enema of the colon showed no abnormality in the colon. On cystoscopy the bladder and ureteral orifices were normal. A pyelogram of the left kidney pelvis showed considerable rotation of the kidney on its axis, so that the ureter emerged from the pelvis on the outer side. A diagnosis of hydronephrosis was made. The right kidney showed a normal pyelogram. On operation the left kidney was found to be low, lying partly in the left iliac fossa. The specimen showed that the main renal vein left the kidney at the hilum, which was on the anterior surface. A small artery entered the hilum at the upper part, but the main arterial supply entered the posterior surface of the kidney, one and possibly two vessels coming from the left common iliac artery. One small artery with a large vein passed behind the posterior surface of the kidney, curved around the outer side, and entered the hilum on its external aspect; these vessels appeared at the operation to be constricting the kidney about its center.

Debenham regards this as a very rare congenital condition.—*R. S. Bromer.*

Fuchs, Felix. Pyelovenous backflow in the human kidney. *J. Urol.*, Feb., 1930, *23*, 181–216.

I. Scope of Problem, Report on Literature and Animal Experiments. The object of this communication is a consideration of pyelovenous backflow, the particular anatomical and hydromechanic peculiarities of which should be established. If one injects fluid into the ureter of a human or animal kidney after removal, the fluid often flows out by way of the renal veins, because of a direct connection between the vascular system and the upper portions of the kidney pelvis. An attempt to establish the practical significance of this phenomenon has been made through animal experiments. Exactly the rôle that the pyelovenous backflow plays in human pathology is the specific object of this paper.

A short survey of the literature, from the first observations of Gigon, 1856, up to the present time is given. Some of the more important points regarding pyelovenous backflow accumulated by different authors are considered. Among these are:

1. The fate of fluid forced under pressure into the kidney pelvis through the ureter. Experimental evidence has shown that such fluid is found in all the tissue elements of the kidney, mostly in the lymph spaces and blood vessels, especially the veins, and least in the uriniferous tubules.

2. The mechanism of the passage of fluid from the kidney pelvis into the veins, as well as into the lymph vessels and uriniferous tubules. Summing up the ezperimental and anatomical findings it may be said that pyelovenous backflow is accomplished by direct communication between the pelvis and venous system, initiated by rupture of the kidney pelvis.

3. The pressure necessary to produce pyelovenous backflow. According to all investigators this pressure is exceptionally small. No difference was found in the required pressure between cadaverous and living kidneys.

II. The Author's Investigations on the Kidneys of Human Cadavers. While there are certain well-recognized differences between the intrarenal topography of the kidneys of mammals and the human, yet in spite of these differences, there are important analogies in the pyelovascular mechanism.

It may be deduced from the investigations of Hinman, Lee-Brown, that the place of pyelovenous backflow is at the apex of a minor calyx, called the fornix calyces in the human kidney. The author has shown by means of a macerated preparation the relation between the fornix calyces and the venous plexus of the renal sinus. He found three-fourths the circumference of the fornix calyces often surrounded by a venous plexus. It is thus clear that the venous circulation in the calyx must sustain considerable injury in event of expansion of the calyx.

The kidney pelvis is regarded as the strongest ductile segment of the upper urinary passages, while the kidney parenchyma lacks an extensive ductility. It is apparent that the

line of separation between the weak and strong parts of the pelvic cavity is at the point of insertion of the calyx in the kidney parenchyma, namely, at the fornix calyces. This is the place of predilection for rupture in the case of internal pressure.

For the purpose of observing the conditions of rupture of the venous system from injected fluid, the author injected normal human kidneys of different ages and as fresh as possible, with 20 per cent sodium bromide solutions. The injections were watched fluoroscopically. The passage of the fluid from the pelvis into the venous channels was accurately noted.

The same phenomenon was studied by means of the corrosion method in which celluloid dissolved in acetone was injected into the ureter until the injection mass appeared at the stump of the renal vein. By this method it was shown that the veins were filled by an extravasation from the fornices calyces.

In spite of these observations it was still not clear whether the fluid which left the pelvis at the fornix calyces, actually entered the surrounding vein stems, and still much less clear why this should be the case. Answers to these questions were obtained by further and more minute study of the anatomical relations of the venous system of the kidney. It was found that an artificial perivenous space was created when the veins were forced away from the adjacent kidney parenchyma by the extravasated fluid from the ruptured fornix calyces. This forceful separation of the vein stem from the parenchyma caused a stretching and rupture of the many small venules emerging from the parenchyma to enter the veins. These ruptured venules thus permitted a direct communication for the passage of the extravasated fluid from the perivenous spaces into the veins.

It is probable that other forms of extravasations, such as subcapsular and sinus-hilus extravasations, which are considerably less frequent than pyelovenous backflow, also result from rupture of small vessels leading to the various types of veins to be found in close relationship with the kidney pelvis.

III. Conclusions for Human Pathology and Clinic. A number of investigators have attributed pyelovenous backflow to a direct penetration of the papillary duct openings of the papillae. The author, while never able to demonstrate this himself, admits its possibility in rare instances and then only at very high pressures.

The pressure at which pyelovenous backflow occurs and whether such pressures occur spontaneously are important questions. It is shown that in renal colic there is an increase in intrapelvic pressure of the kidney and that this pressure is of the same nature and actually exceeds that produced during pyelographic filling of the pelvis. The question is whether these higher pressures cause pyelovenous backflow.

There are two ways by which it may be shown when pyelovenous backflow occurs in humans: (*a*) direct observation by pyelography; (*b*) the reaction of the organism to pressure increases in the kidney pelvis due to artificial or spontaneous causes.

In carefully done pyelographies injections are stopped as soon as the patient complains of pain. The abnormal shadows sometimes seen about the calyces in pyelograms represent the initial stages and not the actual pyelovenous backflow as studied experimentally.

Of more practical importance is the greater pressure produced in the kidney pelvis during attacks of colic. In such attacks symptoms of infection are common. Under such circumstances the author states, "that the septic fever curve in the temperature course of patients with congestion and infection of the urinary passages should always be considered as the clinical expression of pyelovenous backflow waves."

Attention is called to the fact that rupture of veins occurring in pyelovenous backflow may be the source of hemorrhage in such conditions as intermittent hydronephrosis and colic associated with pelvic or ureteral calculi. It is possible that pyelovenous backflow may open the way for ascending infections of the kidney parenchyma.—*Karl Kornblum.*

Campbell, Meredith, F. Cystography in infancy and childhood. *Am. J. Dis. Child.*, Feb., 1930, *39*, 386–402.

Campbell states that two factors in particular account for the fact that cystography has been scantily employed in pediatric cases: (1) lack of appreciation both of the potential diagnostic value of cystography and of its technical simplicity; (2) failure of physicians to seek urologic advice and aid in caring for young patients having obvious disease of the urinary tract. A normal cystogram will be obtained in a great many cases, but, on the

other hand, a certain number will show striking evidence of urologic disease, and with surprising frequency properly interpreted cystograms alone will suffice to establish the correct diagnosis. This paper is based on 150 pediatric cases in which cystography or pyelography was performed.

Cystography is indicated in all cases of urologic disease in infants and children except where an acute infection of the urinary tract is present. Most cases of urinary infection clear up in from two to four weeks irrespective of therapeutic efforts. He believes that all children with persistent pyuria after four weeks of proper medical care should be subjected to a thorough urologic examination. The more longstanding the urinary disease, the greater will be the likelihood of obtaining abnormal cystograms. Cystography is useful also in all neurogenic disturbances of the bladder, and into this group fall a large proportion of the patients commonly designated as enuretic. Many neurogenic cases have a chronic pyuria. Further indications for its use are: a palpable suprapublic mass, evidence of vesical retention, persistent urinary frequency, difficulty, dysuria or vesical pain in children. Hematuria when not due to hemorrhagic nephritis always warrants cystography and usually ureteral catherization and pyelography as well. Campbell has never felt that age was a contraindication. His youngest patient was six days old, and one in six of his patients was less than one year of age.

He describes the technique of cystography very fully. From a roentgen standpoint, preliminary clearing of the intestinal tract is advised, an enema being preferred. The roentgen tube should be over the pubis and directed toward the bladder, so that the vesical outlet will be shown on the films. This is of particular importance in cases of neuromuscular vesical disturbances which are so frequently characterized by a funnel-shaped vesical outlet indicative of internal sphincter relaxation. In young children, the Potter-Bucky diaphragm cannot be used and "flash"exposures must be made between respirations.

The conformation of the normal cystogram varies greatly; the degree of filling is the most important factor. The well-filled bladder is round, oval or pyriform. An uncompressed, partially filled viscus will appear as a kidney-shaped shadow, just as the bladder which is compressed by a low intraabdominal mass. With incomplete filling the bladder dome has a square appearance. If the hips are not squarely on the film (pelvic rotation), the normal bladder usually assumes a direction toward the urachus. Normally, the vesical outlet is not evident on the film; the outline of the lower segment of the bladder is sharply defined. Normally, no ureteral reflux is present. In approximately one-third, 43 cases, of this series a normal cystoscopic picture was found to accompany a normal cystogram. In three-fourths of these, ureteral catherization revealed infection of the upper urinary tract; obviously, this infection had not involved the uretero-vesical valves. On the other hand, no case was encountered that showed an abnormal cystogram when the cystoscopic observations were normal.

Because of the variety of forms of the normal cystogram, the recognition of the abnormal is sometimes difficult. The diagnosis of a normal bladder contour should be made with considerable latitude. Infection of the bladder wall of marked intensity or of long duration is frequently manifested in the cystogram by a fuzziness or motheaten irregularity of the bladder outline, and in this way severe localized mural cystitis may sometimes be diagnosed by the cystogram. With marked cystitis, ureteral reflux will often be noted on one or both sides depending, of course, on the degree of involvement of the uretero-vesical valves. Diverticulosis is indicated by characteristic outpocketings from the wall of the bladder. To demonstrate these, it is advantageous to make roentgenograms from several different angles. Stereoscopic roentgenograms are also useful. Refilling with air, after emptying the bladder of opaque solution, will also assist in demonstrating diverticula and will also show any stones that fill them. Ureteral reflux is due to damage of the uretero-vesical valve mechanism, usually brought on by infection, less often by neuromuscular disease or obstructions of the lower tract with resultant back pressure, aided as a rule by infection. Reflux may extend up the ureters to the kidney pelvis and so obviate the necessity of pyelography. Campbell has never observed reflux in a normal bladder. Previous reports of reflux in normal bladders were found in cases in which cystography was performed under general anesthesia. Gruber has shown that when normal

bladders of anesthetized animals are distended under abnormally high pressure, reflux occurs in some instances. Campbell believes that in his cases which were not done under general anesthesia, normal anatomical considerations prevail and reflux does not occur. In certain cases, the etiologic factor causing reflux must be considered as congenital. In 4 cases seen at autopsy, proof of congenital origin, probably neuromuscular, was obtained. Hypotonia or functional atony of the uretero-vesical valves is sometimes the cause of reflux. Or it may result from back pressure caused by the chronic sphincterospasm of neurogenic vesical disease. Campbell has noted enormous distention of the bladder in choreic children. He has only once observed ureteral reflux in children due to uretero-vesical tuberculosis, secondary to renal disease. On the other hand, non-tuberculous infections are very common and in these reflux is often observed. Reflux is of great clinical importance as by this means, dissemination of urinary infection is greatly aided. Helmholz believes that reflux is of more importance than any other factor in the production of renal infection in the very young. Normal function of the valves may be resumed upon the subsidence of infection, and fortunately reflux from an infected bladder does not always cause immediate renal infection. It cannot be demonstrated conclusively without cystography. Campbell does not believe that spastic contracture of the bladder musculature is a common cause of ureteral reflux. Obstructions of the lower urinary tract are occasionally observed in infants and children, and are of congenital origin in nearly all cases. Congenital contracture of the vesical outlet or congenital valves of the posterior urethra, and chronic sphincterospasm due to the "cord bladder" caused by myelitis, etc., are the most common forms of obstruction of the lower urinary tract. Rarely is obstruction due to urethral stricture found in childhood. Intravesical growths are so uncommon in childhood that they warrant scant comment. They are indicated by motheaten-appearing filling defects of the bladder cavity. Extravesical neoplasia or inflammatory masses may compress the bladder but these also are of rare occurrence.—*R. S. Bromer.*

Stevens, William E. Diseases of the urinary tract during infancy and childhood. *J. Urol.*, Jan., 1930, *23*, 61–80.

A plea for a more thorough investigation and treatment of urologic conditions occurring in infants and children. Attention is called to the fact that these conditions are more frequent than is generally appreciated. A closer cooperation between the general practioner, the pediatrician and urologist is urged.

The same methods employed in adults can be used in the management of urologic problems in children. Certain practical points are emphasized such as the use and choice of anesthetics and the types of cystoscopes and ureteral catheters to be employed.

Some of the more common conditions encountered in children are dealt with. Case reports are cited accompanied by illustrations of pathologic specimens and roentgenograms. Considered under this heading are anomalies of the urinary tract which are not uncommon. The statistical reports of various writers are quoted to indicate the incidence of anomalies.

The paper is based upon a review of the histories of 9115 clinic patients admitted to the pediatric department of Stanford University Hospital. Of this number, 205 suffered from one or more pathologic conditions of the urinary tract. There were 106 males and 99 females. Pyelitis, under which classification pyelonephritis and pyelocystitis were included, occurred in 74 instances, nephritis in 35, phimosis in 28, undescended testicle in 13, urethral stricture in 5, nephrolithiasis in 3, redundant prepuce in 3, hydroceles in 4, tuberculosis of the kidney in 2, trigonitis in 2, anomalies in 2, neuromuscular dysfunction of the kidney in one, abscess of the penis in one, polycystic kidney in one, tumor of the kidney in one, stricture of the ureter in one, hydroureters in one and urethritis in one.

Pyelitis is the most frequent urologic condition in female infants and children. It was found 4½ times more frequently in females than males. While a certain number are self limited many cases require ureteral dilatation and irrigation of the pelvis. These procedures are indicated if no improvement follows a week of conservative treatment, or earlier if the patient is very ill or is rapidly going down hill.

Hydronephrosis and hydroureters, frequent in children, are usually due to congenital strictures of the ureter or urethra.

Tuberculosis of the kidney is relatively uncommon. Bilateral involvement is more fre-

quent in children than adults. This condition is usually rapidly fatal. Early diagnosis is obviously of the greatest importance.

Urethral strictures of congenital origin are not uncommon in both sexes. They occur more often at the external meatus. They respond readily to dilatation. The author believes that improvement of many urinary conditions has often been due to dilatation of an overlooked urethral stricture by the cystoscope.—*Karl Kornblum.*

Braasch, William F. Unusual types of urinary lithiasis. *J. Urol.*, Jan., 1930, *23*, 1–12.

The clinical aspects of various types of unusual urinary calculi are discussed. The first described is the so-called pseudolithiasis or "hysterical lithiasis" observed in individuals who for one reason or other deceptively produce calculi at will. The records of the Mayo Clinic show that 9 such patients have been observed, 8 of them women. Drug addiction is sometimes the cause for such deception. One of the patients whose case history is given had a small bag of pebbles which she would place, when not observed, in the region of the kidney when roentgenograms were made for detection of calculi. The stones which most of the patients carried about with them could easily be recognized as foreign substances from their appearance, although in some instances chemical analysis was necessary to reveal their identity. The patient confronted with such an analysis usually admitted the deception. One should be suspicious of pseudolithiasis in cases of oft-repeated passage of stone and a chemical analysis of such calculi should be made.

A case is reported of a ureteral calculus containing a needle which the patient had introduced into the bladder and which had evidently been regurgitated into the ureter.

Semi-calcified bodies, which are not true calculi are occasionally present in the kidney. The three types most commonly observed are putty-like formations, masses of sandy material and semi-organized blood clots with calcareous deposits. The putty-like formations vary in size and shape and are usually multiple. They may contain only a small amount of calcareous material and for this reason may cast only faint or irregular shadows on the roentgenogram, sometimes resembling the calcified areas in renal tuberculosis. When they encroach upon the pelvis or calyces they may give rise to a filling deformity in the pyelogram resembling a neoplasm. The masses of sandy material giving rise to bizarre shadows of irregular density were found secondary to chronic suppurative pyelonephritis. The third type is that due to calcareous deposits in organized blood clots resulting from hematuria which at times may be due to true calculi.

An unusual type of calculus is that caused by *Proteus ammoniae*. The roentgen shadows cast by these stones may not be as dense as the usual renal calculus and are characterized by unusually rapid growth. These findings should lead one to suspect this condition and the urine should be cultured for the presence of *Proteus ammoniae*.

Among the unusual calculi of interest are those found encysted in the renal cortex a short distance beyond a calyx. Many of these result from cicatricial changes occurring around them in a minor calyx so that eventually they become completely separated from the calyx. In other instances the cyst is primary and the stone forms subsequently. Such calculi are often mistaken for extrarenal shadows. A pyelogram may be of aid in revealing a small communication between the cyst and adjacent calyx. In such cases secondary inflammatory changes are usually found in the other calyces and the pelvis. Pyeloscopy may be necessary at times to reveal the exact location of the suspected shadow.

A brief reference is made to a type of lithiasis which occasionally is observed as a cause of hematuria. On surgical exploration, gross calculi are not found but microscopic examination will disclose the presence of numerous calculi in the renal tubules. Such minute calculi do not show on the roentgenogram.—*Karl Kornblum.*

McCarthy, Joseph F. A consideration of technique in the management of new growths of the bladder. *J. Urol.*, March, 1930, *23*, 323–329.

Some dogmatic conclusions are given relative to the management of new growths of the bladder. Emphasis is laid upon the necessity of accurate diagnosis before any form of treatment is considered. By this is meant a thorough and painstaking study of the patient.

In the roentgen study, three factors should be considered: (1) the presence or absence of

metastasis; (2) any pronounced deviation from the normal in size, conformation or position of the kidneys, and (3) a stereoscopic roentgenogram of the bladder filled with 5 per cent solution of sodium iodide. Finally, where the absence of vesicorenal reflux has been demonstrated, another stereoscopic exposure with the air-filled bladder.

Rectal transillumination should supplement cystocopy. Inspection of the deep urethra should be routinely done. A biopsy should be had in all cases.

The two methods advocated for the treatment of new growths of the bladder are diathermy and radical excision. Each has its specific indications. Total cystectomy should be done more frequently and earlier.

As to irradiation in this form of malignancy, the author states, "Our experience with radium and deep x-ray therapy, under the guidance of physicists familiar with these agents, has been distressingly disappointing. We no longer advocate their use."—*Karl Kornblum.*

Dossot, Raymond. Cancer of the prostate; its origin and extension. *J. Urol.*, Feb., 1930, *23*, 217–245.

A translation from the French in which the author desires to emphasize two points in particular: (1) The relationship which exists between adenoma and cancer of the prostate; (2) the precocity of malignant degeneration.

In regard to the first point, exception is taken to the view held by a group of American authors, who believe that hypertrophy and cancer of the prostate are two conditions absolutely distinct. Reference is made to a series of 450 prostatic cancers reported by Geraghty in 1922 in which there was noted an association with hypertrophy in 75 per cent of the cases. In the series of cases which form the basis of this paper cancer and adenoma were associated in 58.7 per cent of the cases. The author is of the opinion that prostatic adenoma plays an important rôle in the pathogenesis of many cancers. In 11.6 per cent of cases adenomata undergo malignant transformation. Two types of prostatic cancer are distinguished: urethroprostatic adenoid cancer which develops from the adenomatous glands of the prostatic urethra, and true cancer of the prostate which develops from the prostate itself. The latter may coexist with an adenoma.

As regards the second point, the author does not believe that cancer remains limited to the prostate for any great length of time and that by the time it is possible to recognize cancer of the prostate clinically it usually has spread to other portions of the body. This malignant involvement may be to one of the adjacent organs such as the seminal vesicles, which are frequently involved, the bladder, urethra, corpora cavernosa and rectum. The cellular tissues of the pelvis are not infrequently involved. This may be quite extensive which seems particularly to be the result of an especially malignant type of cancer. The kidneys and ureters are secondarily involved as the result of pressure upon the lower ureters or ureterovesical orifice. Involvement of the lymphatic glands is of very great importance and constitutes the broadest obstacle to the radical treatment of carcinoma of the prostate. A review is given of the lymphatics of the prostate with the group of glands most commonly involved in malignant spread from the prostate.

Under the heading of metastases it is noted that visceral metastases are infrequent. Bone metastases, however, are common. Bumpus, who systematically examined his cases roentgenologically, found bone metastases in 30 per cent of the cases. Bone metastases occur especially in the vertebral column (lumbar portion) and bones of the pelvis, after which come the long bones (femur), the skull and the ribs. Such metastases are likely to be passed unnoticed if one does not search for them routinely.

As to therapy, the author regards all forms of treatment, surgery, radium therapy, combination of surgery and irradiation as "frankly mediocre," when directed toward clinically recognizable prostatic carcinoma because of the inability at this stage of the condition to completely eradicate all of the malignant process. The only cases in which the hope of a cure can be entertained are those patients operated upon with a diagnosis of adenoma in whom histological examination shows the existence of cancer. In frankly malignant cases the best one can do is to limit his efforts to palliative therapy; passage of sounds and cystostomy; radical treatment in any form, either by surgery or irradiation, is not advocated.—*Karl Kornblum.*

Nervous System

Lüdin, Max. Ueber Myelographie. (Myelography.) *Schweiz. med. Wchnschr.*, Jan. 11, 1930, *60*, 29–32.

The author presents in this article his experience with myelography and reports 7 cases in detail where the roentgen diagnosis could be checked by either operation or autopsy. He prefers the puncture of the cistern; the lumbar puncture with the injection of ascending lipiodol is, in his opinion, a dangerous procedure and merely interesting from a technical standpoint. The injuries observed in cases subjected to the latter method illustrate this very clearly. The determination of the upper tumor level usually suffices for the surgeon who can obtain a better idea of the extent of the lesion on operation. From the cisterna cerebellomedullaris 2 or 3 c.c. of liquor are removed followed by slow injection of 2 c.c. of warmed 40 per cent lipiodol Lafay with the patient in sitting position. Roentgenograms are taken immediately, 1 to 2 hours, 6 hours, 24 and 48 hours after the injection. During that time the patient must be kept in a sitting position.

Myelography should not be carried out sooner than six to eight days after a lumbar puncture. The typical oil stop which permits the roentgen diagnosis of a tumor may also occur in cases of pachymeningitis hypertrophica and in tuberculous spondylitis. The method may also fail; this is illustrated by 2 cases, one of a psammoma in the region of the 6th to 7th thoracic vertebrae where only a temporary oil stop with a few scattered oil drops were seen between the 5th and 8th thoracic vertebrae, and one of myelitis in the conus terminalis where the roentgenograms showed a permanent stop in the region of the 11th thoracic vertebra. The author did not observe any serious consequences following myelography in his limited number of cases. Slight disturbances as, for instance, rises in temperature, neuralgia located in the limbs, headache and backache are only temporary. Excellent roentgenograms and reproductuions of the tumors found on operation or autopsy illustrate the article.—*E. A. Pohle.*

Skeletal System

Milani, Eugenio. Esostosi osteogenetiche a tipo familiare, associate in un caso con alterazioni discondroplasiche bilaterali. (Osteogenetic exostosis of a familial type, associated in one case with bilateral dyschondroplasia.) *Arch. di radiol.*, Jan.-Feb., 1930, *6*, 55–70.

A case is described in a young man, aged twenty, with no special family history. He developed normally but at the age of puberty there was a certain amount of malformation of the knee to which little attention was paid. But for some time he had had a certain amount of difficulty in walking from swelling of both knees. There was also enlargement of the upper end of the humerus. Roentgen examination showed the knees enlarged, particularly the metaphysis of the right femur; there was a large exostosis on the outside of the metaphysis; it was not very dense and had a large base on the condyle. There was a smaller exostosis on the inner condyle. The epiphysis did not seem to be greatly changed; the joint cartilage on the right was irregular in outline, the metaphysis of the lower end of the right femur was abnormally transparent with rarefied zones, particularly at the implantation of the exostoses. The lower end of the left femur was more regular but less developed. The metaphyses of both tibias were also enlarged. The joint cartilages were very irregular. There were exostoses on the inner sides of both metaphyses and the one on the right especially was abnormally transparent. The heads of both fibulas were swollen and rarefied without any spongy bone but almost homogeneous with oval zones that were more transparent than the rest of the bone. The humeri on both sides were deformed. The cortex was thickened and the marrow canal large. The metaphyses were enlarged with exostoses which formed crests. There was broadening and flattening of the distal end of the humerus with a large flat trochlea. There were exostoses on the lower borders of the ribs.

The sister of this patient, twenty-four years of age, had an exostosis on the outer surface of the upper third of the humerus.

The patient had a combination of dyschondroplasia and osteogenetic exostoses. At the end of two years of observation the exostoses of the knees and the two femurs showed irregular but progressive ossification.

In connection with the case the author discusses the points of difference between exostosis, chondromatosis and dyschondroplasia. —*Audrey G. Morgan.*

COPELAND, MURRAY M., and GESCHICKTER, CHARLES F. Ewing's sarcoma; small round cell sarcoma of bone. *Arch. Surg.*, Feb., 1930, *20*, 246–304.

This group of 60 cases of Ewing's tumor is selected after a comparative study of all the cases of tumors of bone, both benign and malignant, in the Surgical Pathological Laboratory of the Johns Hopkins Hospital (representing in all over 1500 cases together with 1000 cases of diseases of bone). Among 300 sarcomas of bone, 15 per cent were Ewing's sarcoma. The majority (95 per cent) occurred in the first two decades of life. It is rare in all races except the Caucasian.

Trauma seemed definitely related to the subsequent onset of symptoms in all cases in which it was recorded. The average lapse of time between the trauma and the onset was five and a half months.

Clinical Characteristics. Pain was the outstanding symptom in 50 cases (83 per cent) and was the first symptom in 21 cases (35 per cent). The characteristic course of the pain is summed up as follows: Stage 1—Tenderness or soreness following trauma or arising spontaneously on motion. Stage 2—Intermittent pain of dull aching or sharp shooting character. Stage 3—Periods of freedom from pain. Stage 4—Continuous pain, dull or sharp, appearing with progression in size of the tumor or spontaneously, and subsiding after regression in size of the tumor or after operation or roentgen treatment.

Tumor. In 56 cases (90 per cent) a mass was palpable and in 19 per cent a swelling was the initial symptom. Tumor masses varied from small localized swellings to large fusiform masses extending along almost the length of the bone. Vasomotor changes were common with dilatation of surface vessels and in some cases elevation of temperature. The soft parts were usually freely movable. The tumors were totally immobile and apparently continuous with the bone. Variations in the size of the tumors and in the severity of the pain were noted, probably due to hemorrhage and absorption of hemorrhage. The long pipe bones were most frequently involved, the tibia most frequently (915 cases).

Fracture. Pathological fractures were noted in only 3 cases (all of the femur). This is a relatively infrequent complication as compared with its occurrence in other bone tumors (multiple myelomas, 62 per cent; bone cysts, 45 per cent; giant cell tumors, 14 per cent, and general sarcoma of bone, 8 per cent).

Constitutional Reaction. Elevation of temperature was noted in 30 per cent of cases and of these more frequently in the later cases. The average was 100. Bence-Jones bodies were not found. The blood picture varied from normal to a mild secondary anemia. The white counts were from a mild leucopenia to a moderate leucocytosis. Nutritional disturbances were mild until the later stages. Local swelling about the tumor and distal to it was frequent.

Roentgen Studies. The changes are most often diffuse and situated near the mid shaft region of a long bone. Six early cases showed relatively little medullary involvement, slight expansion of the cortex with a periosteal reaction looking somewhat like onion peel. The cortex appeared thickened with some mottling in the region of the medullary cavity due to areas of increased density.

Twenty later cases showed a considerable part of the shaft involved as though the tumor extended more readily in a plane parallel to the axis of the bone. The medullary cavity often showed osteoporosis and the cortex evidence of destruction. Increased density of bone in the region of the widened cortex was the most characteristic finding. Osteophytes arranged irregularly or at right angles to the cortex appeared occasionally. The epiphyses were secondarily involved in 2 cases.

Both the formation of new bone and the destruction of bone are secondary to infiltration of bone by tumor. In the early stages formation of bone predominates, later destruction of bone is seen both in the cortex and medulla. These studies do not support the views that Ewing's tumor is primarily a destructive tumor or that it is of medullary origin.

Gross Observations. All specimens but one showed the bulk of the tumor lying subperiosteally. The medullary cavity was usually constricted or totally occluded by new reactive bone. The widened cortex was due to both subperiosteal and endosteal formation of new bone. Destruction of bone was not a prominent feature; when present it seemed to result from interruption of blood supply where the tumor had invaded and blocked the Volkmann and Haversian canals.

Parallel deposits of new bone occurred when the periosteum had suffered minute separation while spicules were laid down at right angles to the bone when increased separation occurred. These two types of formation of bone duplicate the process observed in the embryo. The soft part of the tumor was usually encapsulated with a thin layer of fibrous tissue which at its margins was continuous with the periosteum.

Microscopic Observations. In compact areas the cell is small and polyhedral with a round nucleus. The cytoplasm is scanty and practically stainless. In less compact areas the cytoplasm has a more definite outline and is faintly eosin stained. The nucleus is deeply stained and mitotic figures not infrequently noted. There appeared to be no intercellular stroma but a fine trabeculation divided the tumor into lobules. The vascularity was variable.

Dissemination and Metastasis. Metastasis has occurred in every case that has to date of writing terminated in death. The most frequent sites were the lungs, lymph glands and skull. The predilection of secondary growths for other bones is thought by some to be proof that the tumor is primarily a multiple disease. the authors do not agree with this. The most frequent bone metastases occur in the skull, spine, scapula and clavicle.

Clinical Course. The onset is with tenderness of the affected part followed by pain either dull or sharp, trauma followed by pain or pain with formation of a tumor. The pain is more or less continuous. Nocturnal pain may be the most severe. Regression of the tumor and diminution of pain are frequent. The temperature may be slightly elevated and there may be localized redness and swelling. To palpation the tumor mass is usually fusiform and continuous with the bone itself. The condition progresses, usually terminating with metastasis, the final symptoms varying with the site of metastasis.

Differential Diagnosis. Early diagnosis is both important and difficult. Inflammatory bone disease is the most frequent preliminary diagnosis. The microscopic changes as well as the symptoms and roentgen findings are similar. Syphilitic periostitis is especially confusing. If a positive Wassermann is found a therapeutic test may be of value. Multiple myeloma is differentiated by the multiplicity of lesions, skeletal deformities, pathological fractures and the presence of Bence-Jones bodies. Osteogenic sarcoma is usually located nearer the ends of the long bones and while it shows radiating spicules, the laminated new bone paralleling the shaft is almost never seen. Irradiation of the tumor is a good therapeutic test, Ewing's tumor responding promptly whereas osteogenic sarcoma is little affected. Metastatic carcinoma occurs later in life and usually shows a single medullary lesion destroying bone at the site of the nutrient artery.

Treatment and Prognosis. In cases where metastases have not occurred amputation for lesions below the upper third of the femur and resection of bones for lesions of the upper extremity, followed by irradiation is the method of choice, as in all diffuse and periosteal malignant lesions of bone. If the lesion is too extensive, irradiation alone may be used until amputation is necessary to relieve pain. Never perform a biopsy and wait for a diagnosis. Frozen section and immediate operation are necessary.

Eight cases (18 per cent) of this series are well after five years from the onset of symptoms and 6 are living over five years after operation. Coley's toxins have no apparent effect. Exploration does not necessarily affect the prognosis in cases in which radical operation or roentgen treatment follows operation.

The Nature of Ewing's Tumor. The conclusion of the study is that the tumor is a malignant sarcoma of bone. In favor of this is the age incidence, its location, the cellular nature, the metastases and the high percentage of fatality. The failure to find a primary focus outside of bone is against the theory of its metastatic nature. The authors do not believe that it is a myeloma originating in the marrow cavity. On the contrary, the evidence points to an origin in either the intracortical or subperiosteal regions, perhaps in the Haversian systems. They also believe that this tumor is not primarily osteolytic.—*P. A. Bishop.*

Copeland, Murray M., and Geschickter Charles F. The nature of Ewing's tumor. *Arch. Surg.*, March, 1930, *20*, 421–436.

A group of 60 cases of Ewing's tumor were selected from more than 400 cases of malignant tumors of bone. The prognosis and ultimate results were available in 52 of these cases by clinical follow ups. The majority (95 per cent)

of cases occurred in the first two decades of life. There was only one negro in this series. The long pipe bones were most frequently affected, principally those subjected to trauma. In all cases the primary growth was on the shaft side of the bone.

Symptoms. Trauma was recorded and seemed definitely related to the onset in 22 cases. Pain was outstanding in 83 per cent and was the first symptom in 35 per cent. A tumor could be palpated in 90 per cent and was the initial symptom in 19 per cent. The average duration of the tumor at the time of first observaton was thirteen and a half months. The masses varied from small localized swellings to large fusiform masses. Surface discolorations were frequently noted. Pathological fractures are rare. Constitutional disturbances and blood changes are slight except late. Internal metastases are late.

As seen roentgenographically Ewing's sarcoma is most often diffuse and is situated near the mid shaft which is expanded by diffuse infiltration, with widening and increased density of the cortex and mottling of the marrow cavity due to areas of increased density. Both new bone formation and bone destruction are secondary to infiltration by the tumor. In early cases bone formation predominates, giving rise to parallel layers or radiating spicules of new reactive bone. In the later stages bone destruction, both medullary and cortical, characterizes the roentgen picture. The authors do not feel that the roentgen studies indicate that the tumor is primarily destructive or that it is of medullary origin.

The pathological changes confirm those of the roentgenogram. The tumor was found to be subperiosteal with one exception. The medullary cavity in some cases contained small portions of tumor, but was usually constricted or totally occluded by new reactive bone. New bone may undergo subsequent destruction when surrounded by the tumor, apparently because of interruption of blood supply when the tumor has blocked the Volkmann and Haversian canals. The parallel layers of new bone are formed when the periosteum has suffered minute separations, the radiating spicules when the separation is more marked.

Dissemination and metastasis occurred in every case that was fatal. The most frequent sites were in the lungs, the lymph glands and skull. The most frequent incorrect diagnosis was "inflammmatory bone disease." Of 52 cases, 43 are dead and 8 (13 per cent) living, with an average duration of life of seven years and eight months.

Treatment. Combined radical operation and roentgen therapy is the method of choice. Exploration does not seem to affect the prognosis when followed by this procedure.

In conclusion, the statement is made that they are unable to state either the site of origin or the histogenesis of this tumor but that they believe that the primary focus is specific for bone and is probably either intracortical or subperiosteal.—*P. A. Bishop.*

Connell, W. W. Thyroid metastases in bone. *Brit. J. Surg.*, Jan., 1930, *17*, 523–528.

The author believes the subject of thyroid metastases in bone is an extremely controversial one, only to be approached with an open mind and in a spirit of inquiry. No convincing definition of malign, as opposed to innocent, tumors exists. In place of a definition one must be content with mere tabulated lists of characteristics supposed to be pathognomonic of the two classes of neoplasm. He reports 2 cases of supposed thyroid metastasis, only one of which came to operation and thus only one pathological examination was obtained. This case was an African woman who complained of a large and painful lump on the back of the head, of three years' duration. There was a fleshy mass about the size of an ostrich's egg projecting from the occipital region of the skull, no exact measurements being given by the author. It was fixed to the subjacent skull and had dilated veins in the overlying skin. A hard and slightly nodular mass could be palpated in the left lobe of the thyroid gland. A hard and fixed gland was palpable in the right subclavian triangle. The patient stated she had had a lump in her neck ever since childhood.

The roentgenogram showed that the outer table, diploë and a part of the inner table of the occipital region of the skull had been destroyed and replaced by the growth described; expansion had been chiefly at the expense of the outer table. The patient disappeared from the hospital and so could no longer be followed. The pathologist reported that the structure of the tumor resembled for the most part a fetal adenoma.

Thyroid osseous metastases, tumors containing thyroid tissue, have been reported previously, but the nature of these deposits has given rise to much speculation. Connell takes the view that all such cases are probably dependent on the presence of a thyroid carcinoma, which may be so atypical, so slow, and insidious, that its true nature is apt to be overlooked. It is incredible that a malignant thyroid can produce a benign metastasis. The suggestion that a benign thyroid may produce either a benign or a malignant metastasis is less unreasonable, and is certainly supported by a good deal of incomplete clinical and histological evidence. At present only a verdict of "not proven" can be returned. Where the risk is not excessive and the metastasis is apparently single, the treatment recommended is excision of the metastasis, followed by thyroidectomy. Prophylaxis depends upon the removal of all thyroid tumors as soon as recognized.—*R. S. Bromer.*

Phemister, D. B. Chondrosarcoma of bone. *Surg., Gynec. & Obst.*, Jan., 1930, *50*, 216–233.

A plea for the recognition of chondrosarcoma as a distinct clinical entity among the malignant tumors of bone. In the classification of the Registry of Bone Sarcoma of the American College of Surgeons this tumor is included under the heading of osteogenic sarcoma, a term broadly used to indicate all malignant tumors derived from bone or from tissue destined to form bone. It is admittedly hard to classify tumors containing cartilage, but since benign cartilaginous tumors or chondromata of bone are quite generally recognized, it would seem equally feasible to recognize a class of malignant cartilaginous tumors. Chondrosarcomata have long been recognized as a class in the European literature and are still so recognized by many American pathologists.

As a means of differentiation the author would designate sarcomata consisting largely of cartilage as chondrosarcomata and those containing tumor bone with cartilage either absent or present only in small amounts in the regions of ossification as osteogenic sarcomata. Chondrosarcomata present sufficiently distinct morphological, clinical and roentgenological characteristics to warrant their designation as a separate entity. Such tumors of the long bones may arise either centrally or peripherally. They are nearly always located in the ends of the shaft beginning some distance away from the epiphyseal line.

Central chondrosarcomata erode the cancellous bone and cortex within, producing an expansible swelling of the shaft. In some cases, this is unaccompanied by new bone formation on the periosteal surface, while in others there is marked periosteal new bone formation leading to a thick shell about the central tumor. There may be a thickening of the cortex above and below the tumor for some distance. Such tumors cast a characteristic shadow in the roentgenogram.

Chondrosarcomata arising peripherally or breaking through the cortex early, with the development of a large peripheral lesion, are likely to possess islands and branching areas of calcification and ossification which produce a characteristic picture on the roentgenogram making it possible to diagnose the condition preoperatively. They may also invade the medullary cavity of the bone, but the characteristic bone proliferation with the formation of a shell, such as is seen in central chondrosarcomata, is absent.

These tumors may also occur in the short or flat bones of the trunk, usually beginning centrally and breaking through the cortex to form an external tumor mass without stimulating thick shell formation.

Some of the chondrosarcomata arise from enchondromata and cartilaginous exostoses. While such an occurrence is relatively rare, it is still more uncommon to find a malignant tumor developing from an exostosis in the condition known as multiple cartilaginous exostosis (hereditary deforming chondrodysplasia). However, a number of such cases have been reported, including one in the present paper.

Ten cases of chondrosarcoma studied pathologically in the laboratories of the surgical clinics of the University of Chicago form the basis of this paper. The histories, the pathological findings, both gross and microscopic, are given in considerable detail. The article is well illustrated with roentgenograms, prints of gross specimens and photomicrographs. Of the 10 cases reported, one is alive 10 years after excision, one 9 years after amputation and one $3\frac{1}{2}$ years after amputation. This in conjunction with the history of long duration in another case would perhaps indicate a better prognosis than that for osteogenic sarcoma.—*Karl Kornblum.*

General

Chipman, Ernest D., and Templeton, H. J. Coccidioidal granuloma. *Arch. Dermat. & Syph.*, Feb., 1930, *21*, 259–278.

A detailed report of 2 cases of coccidioides granuloma giving a description of the lesions grossly and microscopically, details as to cultural studies and the various laboratory examinations indicated in this disease. A discussion as to the treatment proposed by others and that used in the reported cases is given.

In most of the cases of granuloma coccidioides that have been reported the patients have lived in California. San Joaquin Valley has apparently contributed most of these cases. The disease is due to the *Coccidioides immitis*. It is likely to be confused with blastomycosis. It has been also mistaken for syphilis, epithelioma and tuberculosis. Especially is tuberculosis simulated in that in the generalized form of granuloma coccidioides the lymphatic glands and lungs are involved in much the same manner as in tuberculosis.

The disease may be localized or generalized. Few cases of the latter form ever recover. In addition to the lymphatic and pulmonary system, the bones are frequently involved in the generalized form of the disease. In one of the cases reported, discharging sinuses over both iliac bones led to a roentgen examination of the pelvis. A punched-out area was found immediately below the middle third of the iliac crest on the left side. Below this there was an area of sclerosis. On the right side there was a necrotic area near the anterior superior spine while to either side of this area the bone was hypertrophied and sclerosed.

In 23 cases of generalized coccidioidal granuloma reported by Hammarck and Lacey, 21 showed bone involvement. Roentgenologically there seems to be no way of differentiating the disease from tuberculosis of the bone. It has been suggested by Taylor that a proliferative process associated with a particularly fulminating bone destruction is more characteristic of coccidioides than tuberculosis.

At the close of the paper there is an abstract of the discussion by a number of prominent dermatologists. The discussion deals chiefly with methods of treatment.—*Karl Karnblum.*

Matusoff, Irving. Congenital mirror picture dextrocardia with situs transversus, patent ductus arteriosus and subacute bacterial inflammation. *Am. J. Dis. Child.*, Feb., 1930, *39*, 349–353.

Matusoff reports an unusual case of congenital mirror picture dextrocardia, with situs transversus, congenital developmental defect of the heart, probably patent ductus arteriosus and subacute bacterial inflammation, giving no clinical manifestations of the involvement of any valve of the heart.

The diagnosis of patent ductus arteriosus was considered on the basis of the following points: (1) dullness in the upper spaces to the right of the sternum; (2) a thrill systolic in time, over this area; (3) a markedly accentuated pulmonic second sound; (4) the roentgen shadow over the pulmonic area due to increased volume of the pulmonary artery; (5) a systolic murmur of the humming type, transmitted upward and to the right.

The diagnosis of subacute bacterial inflammation was considered because of: (1) a septic fever unassociated with any known focus of infection; (2) an enlarged spleen; (3) emboli in the kidneys; (4) petechiae; (5) a positive blood culture of *Streptococcus viridans*.

It was believed that bacterial inflammation was limited to the patent ductus arteriosus because: (1) There were present all the basic signs and symptoms of subacute bacterial endocarditis, with no known focus of infection in any other part of the body and no clinical signs of endocardial involvement. (2) At no time, and in spite of numerous examinations, were there any murmurs heard near the apex or the aortic areas. (3) The clinical signs in this case are similar to three others cases in which autopsy was performed.

Matusoff summarizes the post-mortem observations in 19 cases of patent ductus arteriosus with infection, and also the frequency of subacute bacterial endocarditis in congenital heart disease.—*R. S. Bromer.*

Belot, J. Un cas difficile d'expertise médico-légale. Diagnostic rectifié par l'examen radiologique. (A difficult case of expert medico-legal testimony; diagnosis corrected as a result of roentgen examination.) *Bull. et mém. Soc. de radiol. méd. de France*, Feb., 1930, *18*, 66–68.

The author describes an interesting medico-legal case in which the roentgen examination

revealed a collapse of the body of the 2d lumbar vertebra, with normal structure and density of the vertebral body and without narrowing of the intervertebral spaces.

The patient who was a chronic epileptic gave a history of trauma. During the army service he fell from the second storey and following this accident a gradual scoliosis of the lumbar portion of the spine developed. Later he was discharged from the army and was suing for compensation. The previous medical diagnosis was Pott's disease.

On the basis of the above roentgen findings the author changed the diagnosis to Kümmell-Verneuil's disease. It is probable that the trauma led to a gradual decalcification of the vertebra involved, resulting in collapse of the vertebral body and subsequent scoliosis.—*T. Leucutia.*

Soiland, Albert, and Meland, Orville N. Radiation service in the modern hospital. *J. Am. M. Ass.*, Jan. 25, 1930, *94*, 239–241.

In a large and active hospital the diagnostic and therapeutic divisions of radiology should be under separate heads in order to obtain the greatest efficiency from both. The therapeutic department should have in all instances equipment which is adequate. Valve tube rectification presents some desirable features. Usually a superficial machine and a deep therapy machine are required. Radium must be employed properly or not at all, and in most instances it is preferable to substitute adequate deep roentgen therapy for inadequate radium treatment. Consequently, it is desirable to possess sufficient radium to make a pack when necessary.

There are many conditions other than malignancy in which irradiation is beneficial, and it is the duty of every radiologist to keep all the other members of the hospital staff informed concerning the value of radium and roentgen treatment in every type of disease.—*G. R. Miller.*

Knutsson, Folke. Uber die Feuergefährlichkeit des Röntgenfilms. (Danger of fire from roentgen films.) *Acta radiol.*, 1929, *10*, 566–587.

The author discusses the danger of fire from roentgen films kept in hospitals, using in illustration reports in the literature of a number of such fires and particularly the Cleveland disaster. In that greatest of film fires half the people in the building lost their lives while in most of the earlier fires there does not seem to have been any loss of life. It is hard to explain the many deaths in this case by the poisonous gases formed by the explosion of the films and the author brings up the question of whether the large death toll in Cleveland was really due to simple film-gas poisoning or whether it might possibly have been due to some other sort of gas poisoning unconnected with the films; he suggests phosgene. He discusses the physico-chemical characters of roentgen films and describes a number of experiments made in setting fire to such films. He then discusses the best way of storing roentgen films from the point of view of safety against fire. He mentions as a model for such storage the large stock department of the Swedish Film Industry at Stockholm, which was built according to principles evolved through a series of preparatory fire tests made by the Government testing office. He advocates the construction by hospitals of fire-proof buildings for the storage of films large enough to give room also for the roentgen films for some years to come.—*Audrey G. Morgan.*

Glocker, R. Die Filmbrandgefahr und die Massnahmen zu ihrer Verhütung. (The danger of film fires and the measures of prevention.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, *41*, 53–56.

The author discusses the circumstances which led to the Cleveland disaster and arrives at the conclusion that the following three factors must be taken into consideration when devising protective means: (1) the prevention of the ignition of the films; (2) the prevention of the extension of the fire to the neighboring structures, and (3) the provision for carrying off the poisonous gases produced by the burning films.

The measures embodying the three above principles are described in detail.—*T. Leucutia.*

ROENTGEN AND RADIUM THERAPY

Galewsky, E., and Linser, Karl. Erfahrungen über Dosierung und Filterung von Röntgenstrahlen bei Hautkrankheiten. (Experiences with dose measurement and filtration of roentgen rays in skin diseases.) *Strahlentherapie*, 1930, *35*, 561–566.

The authors express the opinion that the smallest doses of roentgen rays possible should be used in skin therapy. This is especially true in alopecia areata, alopecia praematura, psoriasis and eczema of the eyelids, eczema of the lip, psoriasis of the hairy scalp, ezcema of the scrotum and anus, and diseases of the female genitalia.

By following the above method no roentgen injuries whatever were observed in a rather large number of cases treated.—*T. Leucutia.*

Zuppa, A. Radioterapie e sclerodermia. (Roentgen therapy in sclerodermia.) *Arch. di radiol.*, Nov.-Dec., 1929, *5*, 967–975.

The author describes 5 cases which he treated by giving an irradiation every week for seven or eight weeks with a spark gap of 35 cm., filter 0.5 mm. zinc and 2 mm. aluminum; 2 ma. and 1/3 of an erythema dose. He found that irradiation of the spinal column is to be preferred to that of the region of the thymus and thyroid or local irradiation of the lesions. Irradiation of the spinal column is always followed by marked improvement or cure of the sclerodermia. Sometimes the condition recurs, but not in less than a year. This treatment should always be tried as it not only cures the local lesions but greatly helps the depressed psychic condition of the patients.—*Audrey G. Morgan.*

Bering, Fr. Ueber Röntgenoberflächentherapie. (On superficial roentgen therapy.) *Strahlentherapie*, 1930, *35*, 250–258.

The author discusses in general outlines the value of superficial roentgen therapy in eczema, neurodermatitis, eczemas of children, kraurosis vulvae, psoriasis, hyperidrosis, acne, lupus vulgaris, furunculosis, skin carcinomas and hypertrichosis.

In connection with this he cautions against the continuation of roentgen irradiation until an atrophy of the skin is produced. Apart from the fact that this can only rarely be obtained, it often results in serious late injuries to the patient.—*T. Leucutia.*

Tranier. Traitement des néoplasmes cutanées en une seule séance avec des rayons moyennement pénetrants. (Treatment of cutaneous neoplasms in one single sitting with rays of medium penetration.) *Bull. et mém. Soc. de radiol. méd. de France*, Dec., 1929, *17*, 313–315.

The following technique is advised for the treatment of cutaneous neoplasms: 32 cm. skin target distance, 200,000 volts, 4 ma., filter: the thickness of the inner coating (oil container) of the Gaiffe drum and 5 mm. Al, 3500 to 4500 r in one sitting (1000 r Solomon corresponding to 8 min. exposure), the surrounding tissues being well protected by lead. In case of large tumors the lesion is divided into several smaller fields. The procedure is considered superior to the fractional method.—*T. Leucutia.*

Gargiulo, Mario. Iridociclite tubercolare trattata con raggi Röntgen. (Tuberculous iridocyclitis treated with roentgen rays.) *Arch. di radiol.*, Jan.-Feb., 1930, *6*, 253–254.

The patient was a young man of eighteen with a family taint of tuberculosis. For about two months he had had photophobia and intense lacrimation of the left eye, with pericorneal injection; the pupil was myotic and did not dilate easily with atropin; there was slight turbidity of the lower quadrant of the cornea where there were fine precipitates on its posterior surface. In the sphincter zone of the iris there were a group of small grayish nodules and a larger one in the upper internal part of the ciliary zone. There were recent synechiae at the border of the pupil and a grayish exudate covered the anterior surface of the lens. Vision 1/10. Antisyphilitic treatment did no good nor did tuberculin treatment. The author gave roentgen treatment with a focus distance of 30 cm., 2 ma., filter 0.5 mm. zinc and 2 mm. aluminum for 20 min. each on Aug. 5, 6 and 7, making a little more than 50 per cent of a skin erythema dose. This technique was used in an effort to avoid the increased tension and hemorrhage of the iris reported in 1927 by Mylius, and the transitory hyperemia of the conjunctiva and iris reported by Scheerer in 1925. There was no sign of hyperemia or increase of intraocular tension during the treatment. The first beneficial effect was decrease of the photophobia and disappearance of the corneal turbidity, and a more prompt and efficient action of atropin. After about twenty days the nodules had disappeared and the iris was normal in appearance. False cataract remained from organization of the exudate on the anterior surface of the lens. Vision 2/10, which may improve still further with a small sphincteridectomy. Clinically the iritis is cured and much more rapidly and completely than with other

treatments. Vision is still defective because of the late beginning of the roentgen treatment and the fact that the iris remained for some time in myosis, thus facilitating deposition of exudate on the anterior surface of the lens.—*Audrey G. Morgan.*

Birkett, G. E. The radium problem. II. Radium treatment of buccal carcinoma. *Brit. J. Surg.*, Jan., 1930, *17*, 498–517.

The factors to be considered in the treatment of any malignant disease are: the primary growth, the immediate lymphatic area of drainage and the more distant metastases, generally in the thorax or abdomen, either blood- or lymph-borne. Radium therapy, Birkett believes, cannot pretend at its present stage to deal with the last factor. The problem of treatment of buccal carcinoma in the lymphatic area of drainage is by no means settled.

Squamous-celled carcinoma appears to spread by embolism. There is no histological evidence of its spread by permeation. Therefore there is no justification for dealing with the primary growth and the gland-bearing areas as separate entities. Thus, Birkett feels that the primary growth should first be treated. Block dissection as recommended by some, interferes with the blood and lymph supply of the affected side and increases the danger of radium necrosis. Unilateral block dissection also diverts the lymphatic flow to the opposite side and the glands there which may not have been previously involved may become so. He recommends that diagnosis be made upon clinical evidence. Analysis of his cases shows that recurrences are frequent after operation. Biopsy is a bad procedure in the interest of the patient. Radium treatment is a conservative measure in the mouth, while surgery often involves a partial or complete glossectomy. He believes that radium can, in a large number of cases, cure the primary growth.

Histologically he divides the lesions of buccal carcinoma into three groups according to their histological characteristics and their anatomical positions. All types respond to radium, but the most brilliant results are obtained in advanced cases at the base of the tongue, a type which is extremely radiosensitive.

Surface applications were at first tried with comparatively intense sources for short periods of time. Then implantations of needles containing radium salts or emanations followed, but the principle of filtration so as to use only gamma rays was not employed. Gradually the intensity of the implanted sources was cut down, and the time of exposure was correspondingly increased. This was the foundation for the modern method of treatment of the primary growth in buccal carcinoma. Regaud combined this principle with the filtration advanced by Dominici. An analysis of about 50 cases which were apparently cured for varying periods, from one to nine years, showed that the principle of prolonged irradiation was responsible for 80 per cent of these apparent cures.

Needles are used in the Manchester and District Radium Institute in preference to removable platinum radon seeds. The seeds have a relatively short active length, needles can be more adequately spaced and will give greater depth of radiation. The success of both of course, depends upon the skill of the operator. Failure to implant accurately means that some part of the tumor is under-irradiated, leading inevitably to recurrence. A minimum filtration of 0.5 mm. of platinum is used. The dosage depends upon the linear intensity or the quantity of radium element or emanation contained per linear centimeter, the screen or the filter, the time of exposure, the number of sources used, and their active length, the position of the sources and their distance apart. Active length of an implanted source of radium refers to that part of the needle which contains radium salt or its emanation. The technique according to the above considerations is as follows: linear intensity, 0.66 mg. radium element, 1.7 to 2 mc. of emanation; screen, 0.5 to 0.6 mm. of platinum; time of exposure, 7 to 12 days; active length, 10 mm. to 30 mm., but the commonest is 15 mm.; number of sources, rarely exceeds 20, distance apart, 1 to 2 cm.

A general anesthetic is given whenever possible, and the preference is for the intratracheal method. Palpation of the growth is essential, and the treatment of growths at the base of the tongue is considerably helped by forcible traction and bimanual palpation. This cannot be adequately performed under local anesthesia. Most authors stress the removal of teeth, but Birkett thinks that it is a definitely bad procedure where the growth lies near, or is in contact with the alveolar margin. A rapid spread often occurs along the alveolar margin as a

result of extraction of the teeth. In cases where a sharp and carious tooth has been the main factor in the production of a carcinoma of the middle third of the tongue the extraction of this tooth is beneficial, but Birkett believes that it is advisable to proceed with treatment rather than to cause delay by a widespread removal of teeth.

It is extremely important that needles be securely sutured, as otherwise—except where the base of the tongue is concerned—they will scarcely be retained for the full period of time. He describes in detail his method of fastening the needles. He has not come to any definite determination whether the use of radium or emanation is the more desirable. He has a distinct impression that those cases of buccal carcinoma which have developed necrosis have occurred where radium element has been used.

A full and detailed description for the insertion of needles in the various regions of the mouth is given. He does not think it necessary to wear lead plates over the alveoli or the hard palate as advocated by some to protect the bone and the adjacent soft tissues. It is better to remove the needles in some cases after five days and reinsert for a similar period under a general anesthetic. Errors of distribution made at the first insertion can be corrected.

With a perfect response to irradiation, in six or eight weeks' time little or no trace will be found of the original lesion. Mobility will at the same time have returned to normal. Under-treatment is characterized by the feature of persistent induration, although ulceration may have disappeared. Over-treatment leads to radium necrosis and if the reaction is marked the patient may succumb from pain, sloughing, exhaustion, inability to sleep, or to take food. Necrosis of bone is sometimes met with, but on the whole is not very frequent. Bronchopneumonia has occurred in 2 or 3 patients out of a total of 400. Hemorrhage was noted in only one case, and probably was the result of ulceration through the wall of the lingual artery and was easily controlled. In over-treated cases where a thick scar results, ulceration may occur in the center a year or more after the treatment. If a high standard is observed in the assessment of a primary cure, local late recurrence is extremely rare.

The technique for treatment of the lymphatic area is described. There are 3 main types of cases: (1) those in which there are no palpable glands; (2) those in which there are palpable glands, either uni- or bilateral, and sufficiently mobile for radical surgical removal; (3) those in which there is unilateral and bilateral glandular involvement too fixed for surgical removal.

Results of Treatment. No five year figures are available. Functional results are almost perfect, especially in the tongue. Mobility is scarcely impaired, and only slight defects are noted when the tongue is protruded fully. As a palliative measure for the primary growth radium has fully justified itself as a therapeutic measure. The percentage of cure for the 1926 cases is 22.50; for the 1927 cases, 34.7; for the 1928 cases, 45.13.—*R. S. Bromer.*

Schurch, O. Ueber Voraussetzungen einer erfolgreichen Therapie beim Mundhohlenkarzinom. (What is essential for a successful therapy of carcinoma in the oral cavity.) *Schweiz. med. Wchnschr.*, Feb. 1, 1930, *60*, 96–101.

The author has collected and analyzed 202 cases of carcinoma in the oral cavity which were observed and treated in several hospitals in eastern Switzerland from 1919 to 1928. One hundred and forty-eight cases had carcinoma of the tongue and floor of the mouth, 5 cases had an involvement of the lower jaw, 7 cases had carcinoma of the buccal mucosa. In 20 cases the palate was involved and 22 cases had carcinoma of the tonsils. In 123 patients the histological diagnosis of cancroid could be made. In 71.2 per cent there were definite metastases while in 17.89 per cent the glands were not larger than a hazelnut and in 11 per cent no metastases could be found. Ten of the 202 cases were women; the average age was 55½ years. Syphilis was proved in only 5 cases, leucoplakia in 8 cases, excessive smoking in 54 cases. In 17 cases there was carcinoma in the family history. The average time between the appearance of the first symptoms and the beginning of the hospital treatment amounted to about four months; the interval between the appearance of the first symptoms and the first consultation with a physician to about two months. An incorrect diagnosis was made in at least 27.2 per cent of the patients; 69 per cent died either in the hospital, having a recurrence while there or had a recurrence shortly after leaving the hospital. In 5 cases there developed an esophageal carcinoma in addi-

tion to the oral cancer. The treatment consisted in the majority of cases of operation; some tumors were coagulated and very few were treated by roentgen rays or radium. The author concludes that under the present conditions in his district the percentage of temporary cure cannot exceed 18 per cent in all cases of carcinoma of the oral cavity. The most important factor in improving these results is early diagnosis and early treatment.—*E. A. Pohle.*

Cola. La Rontgenterapia dell'asma bronchiale. (The roentgen therapy of bronchial asthma.) *Arch. di radiol.*, Jan.-Feb., 1930, *6*, 283.

There is a great deal of literature on the roentgen treatment of bronchial asthma and all authors are agreed that it is very effective and absolutely harmless. But they are not so well agreed as to the best method to be pursued. After testing a number of the methods the author comes to the conclusion that the best results are obtained by irradiating the hypophysis or thorax, or preferably associating the two. Absolute cure is only brought about in a certain percentage of the cases, mostly in young subjects and uncomplicated forms of the disease. In the majority of cases there are longer or shorter remissions in the attacks and a great decrease in their intensity. The treatment does not lose its effectiveness on repetition.—*Audrey G. Morgan.*

Nicotra, A. Casi di fibro-angiomi del cavo nasale curati con la Roentgenterapia. (Cases of fibroangioma of the nasal cavity treated with roentgen therapy.) *Arch. di radiol.*, Jan.-Feb., 1930, *6*, 255–261.

The author has treated 4 cases of fibroangioma of the nasal cavity successfully with roentgen rays. Only 2 of them are described as they are the only ones of which he had roentgen pictures. He used rays filtered through 0.5 mm. zinc and 3 mm. aluminum, with fields of various size depending on the region; focus skin distance 25 cm. Depth dose about 100 per cent divided and given through various fields. The next treatment was given after twenty days and after that still other periodical treatments with depth dose of about 70 per cent. After the second or third treatment there was a little hemorrhage which in the first case was serious enough so that the treatment was stopped for a few days. The first treatment was divided into brief periods of about ten minutes each so as to avoid too great congestion of the angiomatous tumor resulting in hemorrhage. This technique is also designed to cause thrombosis of the most peripheral veins which also decreases the danger of the hemorrhage which the later and stronger doses might cause. The tumors began to decrease in size after the first treatment and there were no disturbances of any sort except the hemorrhage already noted. The tumors finally disappeared entirely leaving the nasal cavity unobstructed, and the patients' general condition improved. So far there has been no recurrence. In the first case described, operation was performed two years ago. In the second, it was performed only three months ago and there were signs of malignancy so it is possible that there may be recurrence in that case. The author thinks roentgen therapy is to be preferred to surgery or radium therapy in these cases as it causes less hemorrhage and there seems to be less chance of recurrence if roentgen examination is made before treatment to determine the exact extent of the tumor.—*Audrey G. Morgan.*

Smith, George G., and Peirson, Edward L. The value of high voltage x-ray therapy in carcinoma of the prostate. *J. Urol.*, March, 1930, *23*, 331–342.

An analysis is given of 25 cases of prostatic cancer treated with high voltage roentgen therapy. In 15 of the cases some operation had been performed.

The physical factors employed in irradiation were a wave length of about 0.15 Å, 50 cm. distance, filtered through 0.5 mm. copper. A "series" usually consisted of at least an erythema dose over each of two portals, one anterior and one posterior. Sometimes the treatment was directed against the perineum.

The most outstanding effect from irradiation was in the relief of pain. Of the 18 patients having pain, all were relieved. This relief continued for from one to six months.

In some cases the malignancy of the growth appeared to be reduced, as evidenced by improvement in the patient's general condition and in the slowing up of the progress of the growth.

Urinary symptoms must be treated by appropriate measures as they are not improved by roentgen irradiation. The pain due to obstruc-

tion and to cystitis, unlike the other types of pain associated with this form of malignancy, is not affected by irradiation.

No cases are cured by roentgen irradiation but if metastases are not too widespread and the patient's general condition is not too poor, roentgen treatment is of benefit in the large majority of cases. It is stated, however, that the value of high voltage roentgen treatment of cancer of the prostate has not yet been firmly established.—*Karl Kornblum.*

Werner, R. Der gegenwärtige Stand der Röntgenbehandlung des Krebses. (The present status of roentgen therapy of cancer.) *Klin. Wchnschr.*, Feb. 8, 1930, *9*, 264–269.

This is a practical article dealing in the first part with the fundamental principles and in the second part with the practical application of roentgen therapy. The value of the method is discussed in tumors of the brain, of the pituitary gland and of the maxilla, in cancers of the mouth, tonsil and hypopharynx, in struma maligna, in mediastinal tumors, carcinoma of the breast (pre- and postoperative value), carcinoma of the esophagus, intra-abdominal and gastrointestinal tumors, carcinomas of the genitourinary tract, as well as in seminomas, sarcomas, and skin cancers. In many instances roentgen therapy must combine with local application of radium. Generally, one may say that the field of radioactive substances is gradually becoming broader while that of roentgen rays is being found limited. A further development of apparatus might reverse this relation. —*T. Leucutia.*

Krause, Paul. Ein Beitrag zur Kenntnis des Röntgencarcinoms als Berufskrankheit. (A contribution to the knowledge of roentgen carcinoma as an occupational disease.) *Strahlentherapie*, 1930, *35*, 210–219.

In 1911 the author collected all roentgen carcinomas recorded in the literature and found that there were 94 cases, 24 of which were lupus roentgen carcinoma. In 1928, 126 cases were added, 9 of which were occupational roentgen carcinoma.

In the present article the author describes in detail a case of a roentgen carcinoma which occurred in a man fifty years of age who for a period of twenty-five years had worked with roentgen rays. In 1902 the patient suffered a roentgen burn which resulted in a severe roentgen dermatitis. This took a long time to heal and later small wart-like new-growths and areas of keratoses developed on the base of the roentgen burn. Since 1922 the patient had numerous operations and the microscopic examinations revealed the presence of carcinoma. For the last few years the extension of the carcinoma was rather rapid and in November, 1928, the patient died. At post mortem there was evidence of rather extensive metastases.

In connection with this the author discusses the several phases of occupational roentgen cancer such as the incubation time, surgical treatment by repeated amputations, inadvisability of the application of irradiations and the importance of protective means. Roentgen carcinoma as an occupational disease must disappear.—*T. Leucutia.*

Lockhart-Mummery, J. P. The use of radium in the treatment of rectal carcinoma. *Brit. M. J.*, Jan. 25, 1930, *1*, 139–140.

Radium in the treatment of rectal malignancy is still in the experimental stage. No definite conclusions concerning it can yet be drawn but it is at this time that the exchange of views and experiences is important. Radium may be used: (1) as an adjunct to excision; (2) as a treatment for inoperable cases; (3) as a substitute for operation.

The only justifiable treatment for rectal carcinoma is complete removal of the rectum and surrounding tissues. Radium needles may be implanted to decrease the extent of tissue to be excised. Several cases have been treated by local removal plus radium implantation. Colostomy was not desired by these patients. The results may prove sufficiently successful to warrant further trials.

The dosage of radium in inoperable cases and the technique of its application are still unsettled questions. The most satisfactory results have been obtained with 2 or 3 mg. needles screened with 1 mm. of platinum and rubber. The needles are placed 1 cm. apart, exposing the growth to uniform irradiation. A total dose of about 6000 mg-hr. (size of growth not stated) is given and the needles withdrawn.

Radium is not a substitute for surgery in operable cases of rectal carcinoma. Its best results are in anal epitheliomata.

Inaccessibility, infection and susceptibility of normal rectal tissue make radium applica-

tion difficult in rectal carcinoma, and fibrosis from the first effect makes subsequent implantation very difficult. Improvements in technique seem to lie in the direction of: (1) increased screening; (2) radon seeds; (3) better asepsis in wounds of access.—*G. R. Miller.*

Borak, J. L'importanza dell'actinoterapia nel trattamento del morbo di Basedow. (The importance of radiotherapy in the treatment of Basedow's disease.) *Arch. di radiol.*, Nov.-Dec., 1929, *5*, 976–987.

Both surgery and radiotherapy act directly on the secretion of the thyroid, the former by decreasing the secreting surface, the latter by decreasing the secretion itself. Both may cause an increase of the signs of hyperthyroidism as an immediate result. Surgical treatment may eventually become necessary in any case, so while surgery may be said to stand at the head of methods of treatment for Basedow's disease, radiotherapy certainly stands at the head of conservative methods of treatment. And there are many cases in which surgery is impossible or inadvisable for one reason or another in which radiotherapy is absolutely indicated. Any internal treatment of Basedow's disease not associated with radiotherapy may be considered an incomplete treatment. The radiotherapy should be given in such a way as not to interfere with the performance of surgical operation which may later become necessary. Roentgen and internal treatment should be tried first and if they fail surgery must be resorted to.—*Audrey G. Morgan.*

Florin, Marie. La Curietherapie dans le traitement des metropathies hemorragiques de la menopause. (Curie therapy in the treatment of hemorrhagic metropathy of the menopause.) *Schweiz. med. Wchnschr.*, Jan. 11, 1930, *60*, 34–38.

The treatment of the menorrhagic metropathy during the climacteric by intrauterine radium application is recommended in this article. A single dose of approximately 2000 to 2500 mc-hr. filtered through 1.0 to 1.5 mm. of brass plus 0.1 to 0.75 mm. of aluminum, suffices in the average case to bring about permanent amenorrhea. A diagnostic curettage should always precede the radium insertion in order to rule out a malignancy. The technique of the intrauterine application is related in detail; if carried out properly it is, in the opinion of the author, without danger. The percentage of cures can be as high as 95 per cent; the only contraindication recognized is a thickening of the adnexa. In such a case irradiation might stir up an old inflammatory process.—*E. A. Pohle.*

Nicotra, A. Recerche istologiche sulla mucosa uterina dopo la castrazione radiologica. (Histological study of the uterine mucous membrane after roentgen castration.) *Arch. di radiol.*, Jan.-Feb., 1930, *6*, 268–282.

After roentgen castration the patient has two or three menstrual periods which are apparently just like normal periods. This is in contradiction with the usual theory that menstruation depends on the corpus luteum, for these are menstrual periods without a corpus luteum. In endeavoring to explain them the author gives a detailed description of the uterine mucous membrane after irradiation and discusses the various theories of the cause of menstruation. The fact that the number of menstruations after roentgen castration coincides with the number of ovules liberated at each period suggested to him that the stimulus to menstruation may be furnished by the ovules themselves. In the normal sexual cycle the maturation of new follicles due to the cessation of function of the corpus luteum is the cause of the death of the one, two or three ovules which have been liberated during the last period. Irradiation of both ovaries with a castration dose destroys all the mature and maturing follicles. So the cause which generally produces the death of the one, two or three liberated ovules is abolished and these ovules therefore bring about the corresponding number of menstrual periods. To prove this hypothesis will require a more complete and detailed study of the normal sexual cycle in woman.—*Audrey G. Morgan.*

Thibaudeau, A. A., and Burke, E. M. Carcinoma of the cervix uteri; an investigation of the relation between the histological findings and the results of radiation therapy. *J. Cancer Research*, Oct., 1929, *13*, 260–267.

Attempts to determine prognosis upon the basis of the histological structure of neoplasms have been numerous of recent years. In this presentation the authors have compared 28 cases of carcinoma of the cervix uteri, having a five year cure, with a similar number of fatal

cases upon the basis of the histological classification suggested by Broders and the malignancy index after the method of Hueper.

The cured cases had been treated by radiation: The cases were divided into five clinical groups as follows:—

Group 1. Cases in which the malignancy was confined to the cervix.

Group 2. Cases in which the tumor had spread to the adjacent vaginal wall.

Group 3. Cases in which there was beginning thickening of one or both broad ligaments but with the uterus still movable.

Group 4. Cases in which the uterus was fixed.

Group 5. Cases in which there was recurrence after removal of the uterus.

For the purpose of comparison the same number of cured and uncured cases were taken in each group. The results in each group are tabulated.

In the histological classification of Broders there are three groups,—group 1 is the least malignant, group 3, the most malignant. In the malignancy index of Hueper, the higher the index the greater the degree of malignancy. From the tables presented it is seen that there were many tumors with either a high malignancy index or a high histological grouping or both, among the cases in all the clinical groups which recovered, while some of the fatal cases in the same clinical groups showed a low histological grouping and a low malignancy index. From this it is concluded that histological grouping and malignancy indices are of limited value in prognosis in cases of epithelioma of the cervix uteri and it would seem that factors, other than those thus far investigated, must be at least as important in the determination of the degree of malignancy in any given case.—*Karl Kornblum.*

Washburn, Alfred H. Chloroma; report of a case with recovery following roentgenotherapy, with a review of the literature. *Am. J. Dis. Child.*, Feb., 1930, *39*, 330–348.

Aside from the statistical value of reporting a case of chloroma which is relatively rare, Washburn believes he has ample justification for reporting his case because of the apparently complete recovery following roentgen therapy. Two and one-half years have elapsed so uneventfully since the treatment was instituted that a preliminary report seems worth while, to be followed by a final report should the patient suffer a recurrence of the disease at some future date.

His review of the literature through June, 1929, shows at least 162 cases of chloroma reported since 1823. Although the majority of recent cases have been myelogenous and there is much in favor of the classification of chloroma as a form of myelogenous leucemia, it does not seem possible to deny the probable existence of lymphatic chloroma. His case was a boy, aged twenty months. Roentgenograms of the skull showed erosion of the outer plate by a tumor mass. Those of the lungs revealed a large mediastinal mass, interpreted as a lymph node metastasis. Those of the long bones brought to light a destructive lesion of the right femur, apparently a metastatic tumor growth. There was also a small area of decreased density in the lower end of the right tibia. The tumor mass in the head was operated upon and the conclusion, from the examination of microscopic sections of the excised tumor, was an apparent myelogenous tumor. The additional evidence gained from the gross appearance of the tumor and the examination of the smears from the fresh tissue seemed to justify the diagnosis of chloroma.

From Dec. 6, 1926, to May 9, 1927, the patient received seven treatments, each treatment consisting of two or three areas of exposure. All of the treatments except one represented 50 per cent of the skin tolerance dose. In view of the patient's poor condition and the widespread character of the tumor process it seemed wiser to give a relatively longer course of small doses rather than a shorter course of full erythema doses. In May, 1927, the roentgenograms showed no more evidence of bone destruction. The patient's condition was checked in May, July, and September, 1927. During this period the healing process in his bones which had begun under roentgen therapy had continued, and there was no evidence of any recurrence of the disease. The only abnormalities in his blood were a mild leucopenia and a few myelocytes. Ten months after the last treatment his health was still excellent and roentgenograms at this time showed practically complete healing of all the bone lesions. Clinically there was no evidence of the disease. In December, 1928, seventeen months later, there was no sign of recurrent disease. In May, 1929, there again was no recurrence and

his blood was within normal limits. The roentgenograms showed complete healing with no evidence of any new lesions.

The pathologic study of the biopsy specimens definitely ruled out both neurocytoma and endothelioma. The age of the child, the location of the tumors, the green color of the fresh specimen and the number of myelocytes in the blood stream all seemed to clinch the diagnosis of chloroma, so far as it was possible to do so without an autopsy. Roentgen therapy was tried merely as a last resort because of the natural desire to do something for the patient, not with any faith in its curative power. Because the author had found no other record of the use of the roentgen ray, he has given in his report a full list of the exposures in tabular form. He feels that one cannot escape the conclusion that the patient's recovery was directly dependent on the treatment given.—*R. S. Bromer.*

Epifanio, G. Irradiazioni Rontgen del plesso solare. (Roentgen irradiation of the solar plexus.) *Arch. di radiol.*, Jan.-Feb., 1930, *6*, 286.

The author used irradiation of the solar plexus in celiac neuroses, gastric neuroses, gastric ulcer and diabetes insipidus. Among the celiac neuroses, the neuroses of the vagal type, such as those which accompany hyperchlorhydria and pylorospasm were particularly favorably affected. The author had good results in mixed forms and forms brought about by hypertrophy of the preaortic and mesenteric glands. He had similar results in gastric neuroses, which may be considered partial syndromes of celiac neuroses. The effects were good in nervous, motor and secretory neuroses. In stomach ulcer roentgen irradiation of the solar plexus regulates neurotrophism and gastric secretion. In diabetes insipidus there was decrease of the polydipsia and polyuria. The decrease of polyuria seemed to be brought about by decrease of the feeling of thirst. Irradiation of the celiac plexus in diabetes insipidus should be associated with irradiation of the hypophysis and mesencephalon.—*Audrey G. Morgan.*

Cola. Crisi di epatargia durante il trattamento Rontgen del morbo di Banti. (Attacks of hepatargia during roentgen treatment of Banti's disease.) *Arch. di radiol.*, Jan.-Feb., 1930, *6*, 285.

In one case of treatment of Banti's disease with roentgen rays the author saw a sudden increase in the signs of latent insufficiency of the liver and in another case a severe and fatal attack of hepatargia. As these serious results followed moderate irradiation in both cases, which however had acted on the left lobe of the liver as well as the spleen, the author thinks they must have been due to the action of the rays on the liver. Though normally the liver is very resistant to roentgen rays it is very sensitive to them in some degenerative and inflammatory conditions and he thinks that in these two cases of Banti's disease the irradiation of the liver aggravated a latent condition of insufficiency of the organ. He thinks that irradiation of the liver should not be practiced in diseases in which there is hypofunction of the liver, and in Banti's disease, in which liver insufficiency is always imminent, care should be taken to irradiate only the spleen and roentgen treatment should not be used in very severe cases.—*Audrey G. Morgan.*